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computing today

AUGUST 1980
ISSN 0142-7210
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FOR THE BUSINESS OF MICROCOMPUTING

BUSINESS IN A MESS?

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8K ON BOARD MEMORY!
5K RAM. 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

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with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

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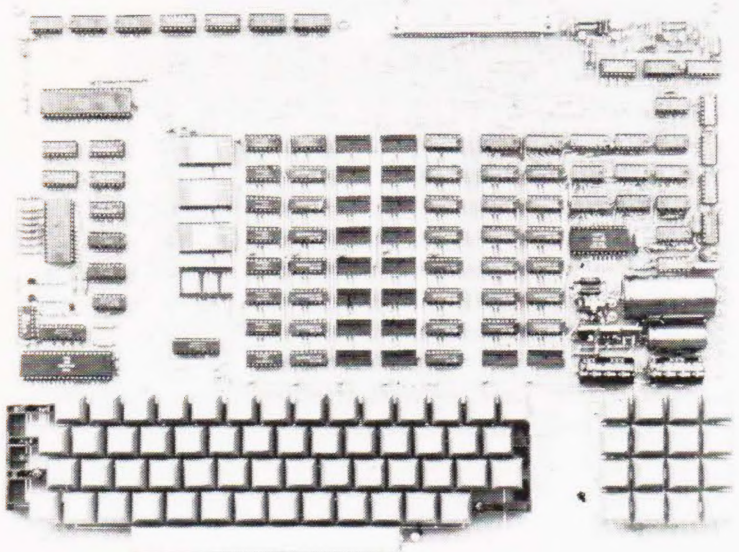
PSI Comp 80.Z80 Based powerful scientific computer Design as published in Wireless World

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete!

Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board, 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer, 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.



KIT ALSO AVAILABLE AS SEPARATE PACKS

For those customers who wish to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") **£43.20**. Pair of keyboards **£34.80**. Firmware in EPROMS **£30.00**. Toroidal transformer and power supply components **£17.60**. Cabinet (very rugged, made from steel, really beautifully finished) **£26.50**. P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our FREE CATALOGUE.

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Expansion up to 32K all inside the computer's own cabinet!

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	Set of components including IC sockets, plug and socket but excluding RAMs.	**£11.20**
	Complete set of board, components, 16 RAMS	**£89.50**
8K ROM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.40**
	Set of components including IC sockets, plug and socket but excluding ROMs	**£10.70**
	2708 ROM (8 required)	**£8.00**
	Complete set of board, components, 8 ROM's	**£78.50**

Value Added Tax not included in prices

PRICE STABILITY: Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until September 30th, 1980. If this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.

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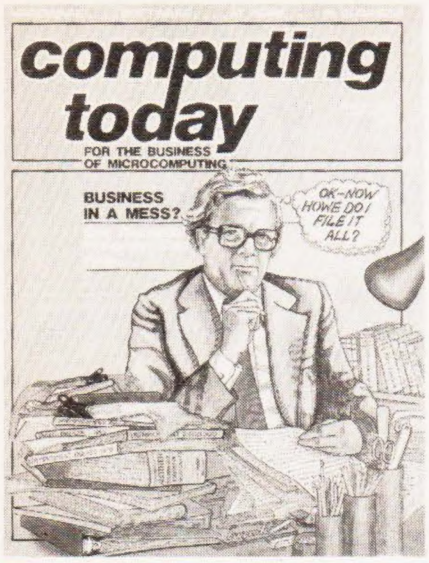

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Telephone 01-437-1002/7.

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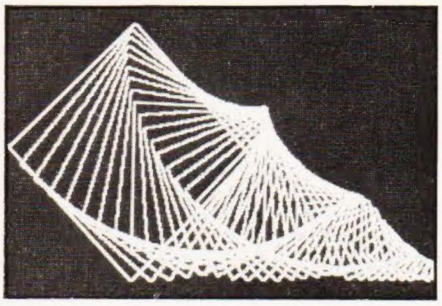

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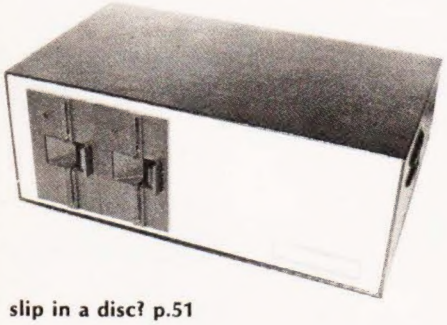

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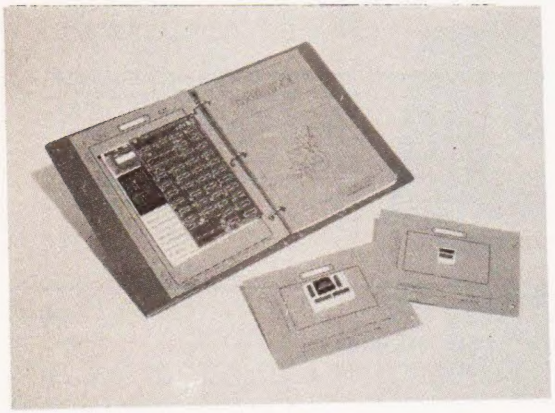
MICROTAN 65

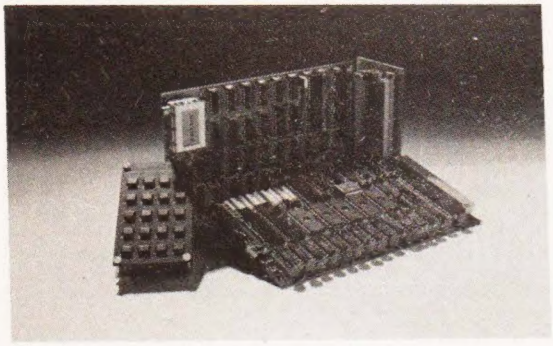
£69 plus VAT

The Microcomputer that thinks it's a Mini



The MICROTAN kit has won widespread acclaim for it's super presentation.

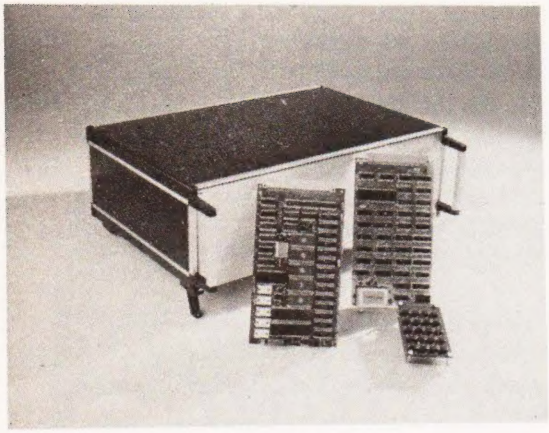
High quality, plated thru' hole printed circuit board, solder resist and component legends. Full set of I.C. sockets. 64 way D.I.N. edge connector. 6502 microprocessor. 1K monitor TANBUG. 1K RAM for user programme, stack and display memory. VDU alphanumeric display. Intelligent keyboard socket. A4 MICROTAN 65 system file binder. 136 page, bound, A4 size users hardware/software manual with constructional details and sample programmes. Logic and discrete components to fully expand MICROTAN 65.



TANEX — from £43.00 plus VAT

Fully expanded TANEX offers; 7K RAM, 6K ROM, 8K MICROSOFT BASIC, 32 parallel I/O lines, two TTL serial I/O ports, a third serial I/O port with RS232 20mA, full modem control and 16 programmable baud rates, four 16 bit counter timers, cassette interface, data bus buffering and memory mapping.

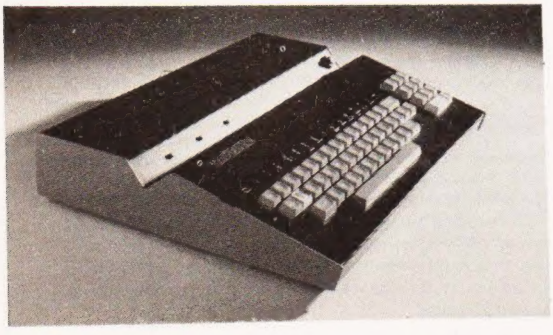
Ready built the mini-mother board has two 64 way female connectors, a 4 way power supply connector and a reset switch on board. It is used to connect MICROTAN to TANEX, and will fit inside the mini system rack. **£10.00** plus VAT.



Full System Rack — from £49.00 plus VAT

For the man that has everything! 19 inch wide system rack which accepts MICROTAN 65, TANEX, TANRAM, **NINE** FURTHER EXPANSION BOARDS, TANDOS AND THE SYSTEM POWER SUPPLY.
Available in many formats e.g. Individual module front panels, full width hinged front panel, back panel with or without connectors, etc.

We have produced a mini-rack which accepts MICROTAN 65 and TANEX, it has an integral power supply, just plug it into the mains and away you go! Finished in Black/Tangerine/ Brushed aluminium, it gives your mini-system the professional finish. **£43.00 plus VAT**



Full ASCII keyboard — £49.00 plus VAT

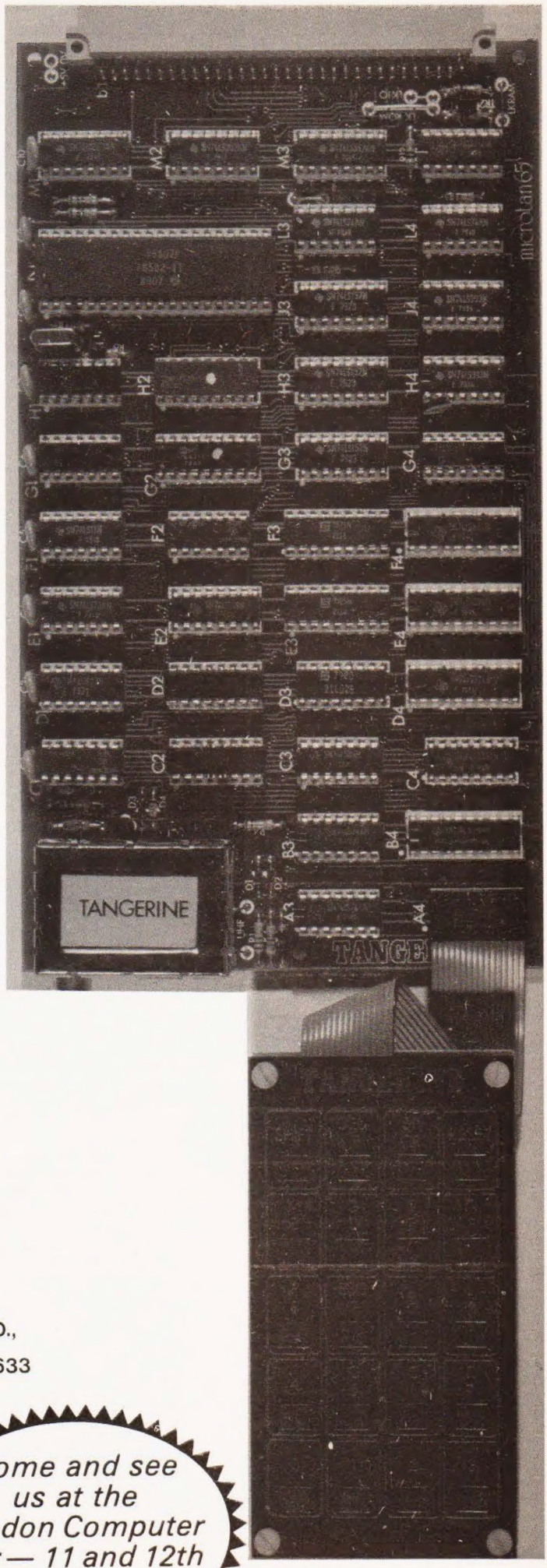
The ASCII keyboard includes a numeric keypad and ribbon cable connector. Available only as fully built and tested.

Cabinet available at **£20.00** plus VAT.

TANGERINE
COMPUTER SYSTEMS LIMITED

Extract from Mini Review in ETI *April 1980*

- An excellent kit
- The concept of TANBUG is excellent
- Rock steady VDU
- The extremely reasonable cost has not been achieved by skimping on design
- A gem of a product
- An excellent introduction to 6502 based systems



- A 6502 based microcomputer.
- Superb 1K monitor TANBUG.
- Expansion boards to make a full system.
- Fully socketed
- 1K RAM for user programme, stack and display memory
- 136 page software/hardware users manual, with example programmes and A4 size!
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- Full alphanumeric video display on an un-modified domestic TV – makes programming much easier
- Optional lower case pack £9·48 + vat
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Come and see us at the London Computer Fair — 11 and 12th July

MICRO METER

This nifty little DPM has an extra trick up its sleeve, not only can it display 4½ digits and transmit a 12 bit binary code to a computer but it appears to have acquired an extra digit on its display between the copy and the photo! The unit is designed to output in either tri-state TTL or via a UART making it ideal for remote and visual monitoring of equipment, etc. Price is quoted at £79 less VAT but whether this includes the free digit we're not sure. Check the spec on this one by contacting John Nichols or Keith Pauley at Office Suite 1, Coach Mews, The Broadway, St Ives, Huntingdon, Cambs PE17 4BN or ring on 0480-63570.

PORTABLE PROCESSOR

Newly launched, and soon to be publicly unveiled, is a portable data terminal from Microdata Computers. Based on a dual processor system, Z80 and F8, and using the Burroughs flat screen plasma display the system is fitted into an aluminium attache case. Supplied with 16K of RAM as standard and with an optional extra 16K the system also uses bubble memory, Texas brand, and has a 1200 Baud CUTS interface for cassette. The system is expected to cost from £3500 and potential users should contact Microdata at Belvedere Works, Bilton Way, Pump Lane Industrial Estate, Hayes, Middlesex or ring Mr B Lumb on 01-848 9871

FLEXY SYSTEM

Yet more modules have been added to the RCS Microsystems 6800 based system including twin parallel I/O, 32K dynamic RAM, PROM programmer and five special purpose interfaces for printers, discs, digital cassette and VDU. Adding these to the existing range gives a very flexible OEM or educational system that is rack mounted and can be modified or adapted to suit individual requirements. All descriptions of the system and its component parts can be found by contacting David Mapes at RCS Microsystems, Gresham House, Twickenham Road, Feltham, Middx TW13 6HA or by phoning on 01-89 4761.

DIGITIZING DOOBRY

People with a need for digits — cartographers, designers and the like — might be interested in a digitizing table from Sintrom. Manufactured by Perex the unit contains all the necessary active electronics in an 11" by 17" by 1.7" thick block. You can select either Imperial mode with an accuracy of .005" on a resolution of .001" or metric mode with either .025mm or .01mm resolution with accuracy of .125mm. Readings are taken with either a cross-hair cursor or a stylus and the output is sent through an RS232 interface. Two models are available and prices range from £1300 to £2600. For details contact Sintrom Electronics at Arkwright Road, Reading Berks

COMPUTERS AND INSTRUMENTATION

The sub-heading on the cover of this volume gives the game away, "a practical handbook of measurement, interfacing and control circuits." This is not a book for bedtime readers but a solid reference manual that could easily find its way on the shelves of technicians, servicemen and indeed anyone with an interest in connecting computers to things. The book starts with a gentle introduction to computers and their structure — both hardware and software — and progresses straight into the world of analogue signals. Brief point of objection in the spelling of analogue, they have used the American version 'analog' which I always thought was a Sci-Fi magazine, and as the author hails from Manchester it is rather odd. Having progressed from analogue to digital and beyond the book comes to rest at Chapter 5, or to put it another way my review copy now falls open at these pages, because this is the section on standard interfaces. It is worth buying the book for this chapter alone, as it covers all those wonderfully brief names like V24, BS4421 (rare in the extreme), IEEE 488 (PET's bus is based on this) and a variety of brief notes on others like CAMAC. For anyone who seriously involves himself in interfacing this is the chapter that makes the book. The following chapter is for people who want to build instrumentation interfaces and, like the rest of the book, contains circuit ideas, examples and techniques. The final chapter gives itself over to speculation on "the ultimate personal computer" and makes interesting — and at times a little amusing — reading. The final paragraph is almost guaranteed to raise a chuckle from even the most serious of readers. As is usual in works of a reference nature there are pages of useful information headed Glossary and it is more than likely that this will become yet another "bible" when the going gets tough in the editorial offices. Overall then, a book with an undoubtedly serious content but lightened by the approach taken and certainly full of vitally relevant information. Computers and Instrumentation is written by A Carrick, published by Heyden, ISBN 0 85501 452 0, and costs £9.75 in hardback. Heyden and Son Ltd can be contacted at Spectrum House, Hillview Gardens, London NW4 2JQ.

DEVELOP THE Z80

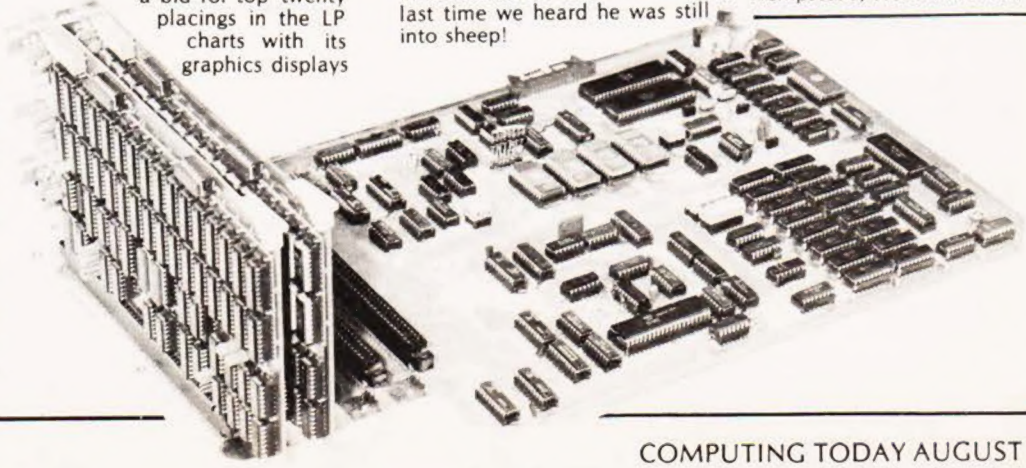
Midwich, the SGS Ates distributor for the Nanocomputer, have just announced a new, low-cost development system for the Z80 based around the same board but in a fully configured state. The system included 16K RAM, 10K ROM, EPROM programmer, video display interface and dual cassette drives together with a number of I/O interfaces. The complete system with full documentation will sell for £1495 excluding VAT and offers a viable alternative to the more expensive disc based type of system. For details of this and all the other SGS Ates range including the Nanocomputer contact Midwich at 9 Churchgate Street, Old Harlow, Essex CM17 OJS or ring David Watson on 0279-412605.

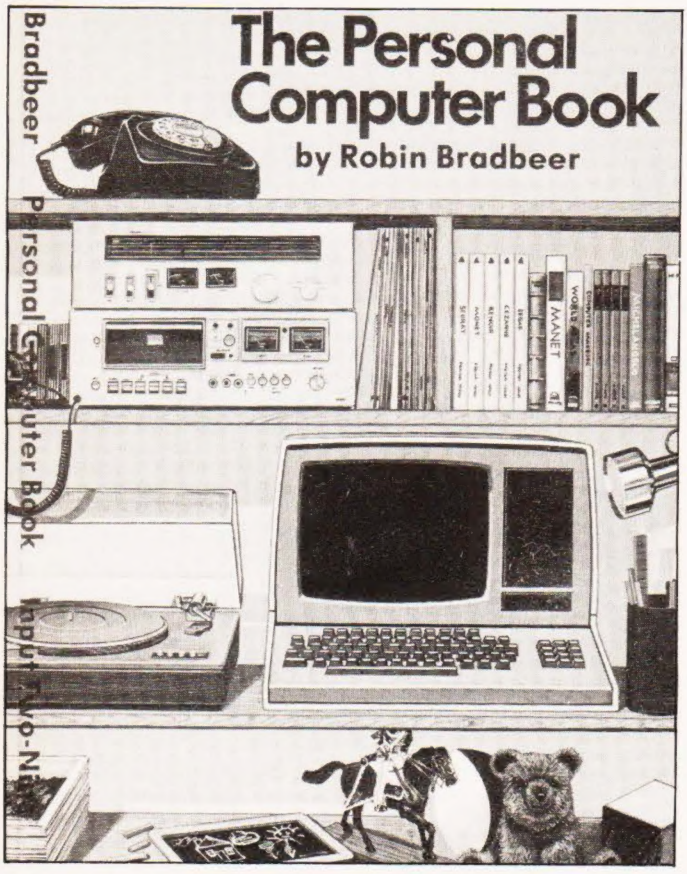
BUMPER CROP

Included in a new brochure from Microsense, the Apple distribution arm of Data Efficiency, is a wealth of add-ons and software for the Apple user. Software information is also included along with details of Apple compatible printers such as the Texas 810 and the Paper Tiger. For your copy contact your local authorised Apple dealer or mail direct to Microsense at Maxted Road, Maylands Avenue, Hemel Hempstead, Herts HP2 7LE.

TRITON WITH TEETH

Newly launched by Transam, of Triton fame, is a new S100 based system that can start from as little as £195. Based on the Z80 processor it is a single board system with five S100 slots to the new IEEE standard and is called TUSCAN. Sold in either kit or built form it offers a wide variety of options in both hardware and software and can be cased in a neat housing which will also be used to house a fully expanded Triton with motherboard etc. Also newly announced by the company is a version of Pascal that will run on the PET, the product is Commodore approved and is supplied on a mini disc for £120 complete with documentation. For full details on both these new products contact Graham Clifton or Nigel Stride at 12 Chapel Street, London NW1 5DH or ring on 01-402 8137. Transam's Triton is also making a bid for top twenty placings in the LP charts with its graphics displays currently featuring on the new Roy Harper album, The Unknown Soldier. We haven't obtained a copy of the LP yet so we can't say whether the micro influence has affected his work, last time we heard he was still into sheep!





THE PERSONAL COMPUTER BOOK

Up until the publication of this book, which we actually managed to get in proof form for early review, there has been no truly "British" look at our personal computer market. Owing to companies like Commodore, Tandy and Apple — to name but three — invading our shores with American equipment one could be forgiven for thinking that there wasn't a British view of the market! This volume explodes that misconception and sets out in very entertaining and readable form the facts on owning a computer. The book takes you through the stages of education necessary to understand the concept of actually owning a computer, what you are likely to be able to do with it and what you can't expect to do with it. Whilst some stages may be trivial in some people's estimation it can be said that the book makes no assumptions as to the readers knowledge, not at all a bad thing. Once again the final chapters and the incredibly detailed Appendices are worth the price of the book on their own. Details are given on a vast range of computers, peripherals and other exotic goodies together with addresses of computer clubs, manufacturers and bus specifications. Even if you own a computer already these chapters are worth obtaining for reference purposes as it is seldom that all this information, so necessary for someone making their "first choice", is assembled in one publication. I strongly suspect that this will be the first of many such books to appear for the "home" market but, in this case at least, the first may well turn out to be the best. The book is to be published at the end of the month and will cost £5.25. The author, Robin Bradbeer is a lecturer at the Polytechnic of North London and is well known for his efforts in promoting personal computing which had led to the formation of the Association of London Computer Clubs and the holding of a privately organised Computer Fair in July this year. The book can be ordered direct from the publishers, Input Two-Nine, if you have difficulty in obtaining it locally. The address to write to is MCB Publications, 198/200 Keighley Road, Bradford, West Yorkshire BD9 4JQ quoting the ISBN 0 905897 56 0.

MOSTEK MISTOOK

There it was in bold type right across the top of the press release, PDP-9 add in memory system. Heads were scratched, minds blown and books consulted. Had DEC, that company of minis, produced a new computer? Well, there was only one way of finding out, ring Mostek from whom the release was released. "What's this new PDP-9 then?" "what PDP-9? OH NO!" Oh yes best beloved how the mighty are fallen. When good old CT has a splng mistake a few tens of thousands may spot it, when a multinational like Mostek do it and then circulate it right round Europe and nobody spots it we begin to feel that there's no justice in the world any more. The actual news item concerned the launch of a new Omnibus compatible memory system for "8s" of the A,E,F and M types and was of 32K by 12 configuration. The board only needs 5 V and single unit costs are $4100. For details of this and all Mosteks other goodies you should contact Mostek (UK) Ltd at Masons House, 1 Valley Drive, Kingsbury Road, London NW9 or ring on 01-204 9322.

SIMULATE A ROM

A new personality module has been added to the range available for the International Microsystems IM 1010 Universal Programmer. The new simulator can emulate any 4 or 8 bit PROM between 32 bytes and 4K bytes in size. The powerful inbuilt editing system allows debugging of programs and the program size can be configured to suit the operator, for example a 4K byte program could occupy one 2732, two 2716 or four 2708s. The unit can be replaced by the appropriate module for the chosen PROM and the program can then be burnt in. The Universal Pro-grammer incorporates a full keyboard and a gas discharge display and is shipped as standard with 4K of RAM, optional 16K is available. There are also two RS232 interfacing ports with variable baud rate and these can be used for direct downloading of software. For further information on the range and their capabilities contact Micro-Image Technology at Green hill Industrial Estate, Riddings, Derby DE55 4DA. Telephone enquiries can be answered on 0773-604411.

A CASE FOR TANDY?

The popular TRS 80 is used for many things from personal computing right up to small businesses but the one thing it lacks is a method of grouping all the component parts together. Tandy themselves do produce a rather utilitarian desk but a new product from Blandford Computers appears to be the ideal solution to the tangled problems of TRS 80 owners. The new case system is capable of housing three disc drives of the miniflopy type, the keyboard and all the necessary mains sockets. The whole unit is supplied complete with hardware as a package, a typical system with 32K of RAM and three drives with VDU and printer would cost around £1950. All the hardware product is available separately and full details of this flexible packaging can be obtained direct from Blandford at Higher Shaftesbury Road, Blandford Forum, Dorset.

LION ROARS AHEAD IN PET MARKET

The Tottenham Court Road showrooms of Lion Computers are the scene for a new, high quality software development for the very popular PET. The new package, developed by Computer Services Midlands Ltd, is of the Incomplete Records type and is designed to run on a 32K machine with dual discs and a printer, the whole package selling for £4000 — including software. The system is interactive in operation and can be used for a wide variety of accounts from sole trade to limited company. The operation is based on double entry and will handle details such as Day Books, Transactions (both cash and bank), and has a number of features that the operator can access such as previous entry recall and VAT analysis. Output reports include Balance Sheet, Audit Trail, etc. For a full description of the new software visit Lion House at 227 Tottenham Court Road or ring Andrew Margolis on 01-580 7383.

CITY IN THE CITY

Right in the heart of decision making territory you'll find City Computer Systems, a team of computer and financial experts. Among their range of impressive software you'll find such packages as PMS, the Portfolio Management System. This on-line system, together with their Dealer Gateway, offers dealers and portfolio managers the access they require to make "buy-and-sell" decisions. If your day to day business is to do with the handling of trust funds or pensions or the like then you should contact City to see just what they have to offer in the way of on-line information systems. The range doesn't stop there though, they are into word and information processing and have, together with their sister company — Monotype International — developed a laser phototypesetting system based around the Vector Graphic MZ computer. For details of this many and varied company contact them at 1/2 Laurence Pountney Hill, London EC4R 0BA or ring Alec Trustram Eve on 01-626 0824.

SUNSHINE COMPUTING

Sun Computer Services have been appointed as a major UK distributor for the Interec range of business computers. Among the models are the twin Z80 based Superbrain models QD at £2650 and DD at £1950 and the intelligent VDU, the Intertube II. Both the Superbrains feature twin floppy drives with 320K, 64K of RAM, CP/M disc operating system and the S100 bus. Full hardware and software support will be given to the range and any interested customers should contact Paul Dockerill of Sun at 138 Chalmers Way, North Feltham Trading Estate, Feltham, Middlesex or ring on 01-751 6695.

GET INTO FILMS

If you want to protect your documents from damage by heat, grease, dirt or abrasion then a new product from Print Lamination Products may be your answer. Available in a variety of standard widths it is a transparent polyester film that can be laminated onto printed materials such as directories, notices and maps to protect against wear. As well as the benefits of protection you can also write on the surface and wipe off later. If your documents need protection then write for details to Print Lamination Products, Newspaper House, High Road, Ickenham, Middx UB10 8LB or ring on Ruislip 31993.

FORGING AHEAD WITH PETAL

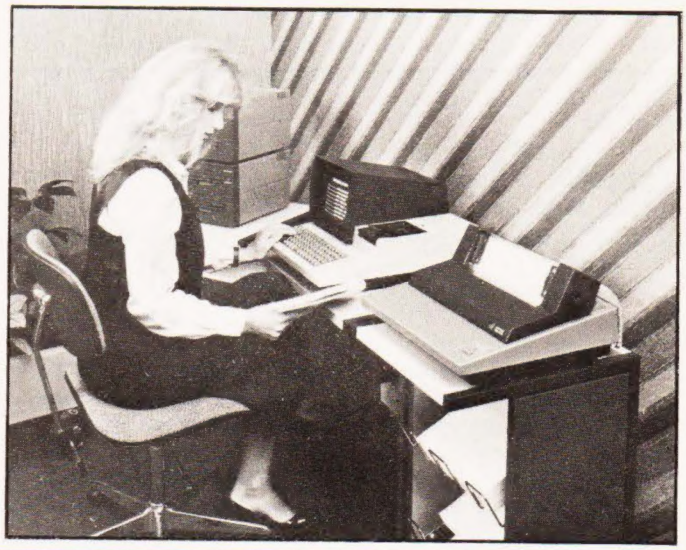
You may be forgiven for thinking that metal bashing and the computer were rather far removed from common ground. In the case of Mark Priest and Sons of Bristol you'd be very wrong. They have taken their accounts department into the eighties with a micro as a helping hand. Using PETAL, a PET based package, they can prepare tapes of sales information at the end of every month and send these to the ACT computer centre for processing by an ICL mainframe. This saves time and also ensures a greater degree of accuracy as the PETAL package checks many of the common errors. The PET is rented at £22 per month and the actual processing costs only £73 because of the preparation done by the micro. For details of the ACT range of bureau and other computing services contact Chris Buckham on 021-454 0344 or write to ACT at 5—6, Vicarage Road, Edgbaston, Birmingham, B15 3ES.

THE VITAL COMPONENT

Having just installed "n" thousand pounds of computer equipment you may find that although you have every last piece of hardware and software you still can't do anything with it. Well, you did remember to order blank discs, tapes and paper didn't you? You didn't! Willis to the rescue with their amazing new, full-colour catalogue of computer room supplies from lowly line printer paper to desks and storage racks. Throw at least one of those manuals off the shelf and put this invaluable catalogue in its place, it's probably worth its weight in gold. For your free copy contact Willis Computer Supplies at PO Box 10, South Mill Road, Bishops Stortford, Herts CM23 3DN or ring on 0279-506491 if you've just seen the last spare disc pack get used as a frisbee by your new operator!

SHARP MEAN BUSINESS

Sharp Electronics (UK) Ltd, the British arm of the company that makes the MZ–80K personal computer is introducing a number of enhancements to the range as well as lowering the end-user prices. The new peripherals announced include an Interface unit that connects to the 50 way bus and costs £99. Having installed this you can then upgrade to twin, single-sided, double-density floppies with a capacity of 280K. Also about to be launched is an 80 column, plain paper line printer capable of printing at 1.2 lines per second and handling all standard alphanumerics as well as a range of graphics. Prices of these two add-ons are £780 for the discs and £517 for the printer. Along with the announcement of the new peripherals Sharp have also announced the new prices of their systems, £480 for 6K, £529 for 18K, £549 for 22K and £599 for the 34K version. This means that a complete small business system with a 34K machine, twin floppies and printer will sell for less than £2000. For further information on any of the range of Sharp equipment please contact Paul Streeter at Sharp Electronics (UK) Ltd., Thorp Road, Newton Heath, Manchester M10 9BE or ring on 061-205 2333.



ADDS UP

A neat desk mounted microcomputer system has been introduced to their range of business machines by ADDS (UK) Ltd. Costing from £4000 (less printer) it is based on an 8085A processor and is equipped with 52K of RAM. There are options of two or three floppy discs of the 8" variety and these can be either single or double sided. A large quantity of software is available, some is included in the price, and the system also features a communications interface as standard for remote processor operation. Language support includes BASIC, FORTRAN and MicroCOBOL. For details of the new range contact ADDS at 137 High Street, New Malden Surrey or ring on 01-949 1272. Watch out for a new range of systems from ADDS soon with apparently remarkable expansion capabilities.

Dear Editor,

The letter from A.S.WADDINGTON "CT June 80" re the Mk14 highlights a dilemma which the thousands of owners of these kits now find themselves in.

Evidently with the arrival of the ZX80 the Mk14 has been dropped without any thought of phasing out with customer consideration in mind.

How long will the ZX80 be around?

However the Mk14 is a good experimenters system and it is a pity that S of C have decided to cut off the supply.

There are a number of enthusiastic Mk14 user groups and the national one is organised by:— Mr. G. Phillips, 8 Poolsford Road, London NW9 6HP.

Yours sincerely,
Cliff Clark.

16 Victoria Gardens,
Palm Grove,
Oxton, Birkenhead,
Merseyside L43 1TH.

Dear Sir,

Having just come out of a state of shock induced by H.Budgett's ZX80 bit, I would like to put pen to paper re Clive's number-cruncher, and the load of utter (insert printable adjective) which made up the article. Here goes!!

1) Why have a switch to ground the reset line?
2) My ZX80 is OK on our colour TV, so fork out for a decent one in future.
3) You say the VDU was 'adequate in definition'. It's a lot better than our Apple at work (and that's a proper monitor!), esp. with a bit of green plastic on the front!!
4) 'The clock circuitry is not controlled by a crystal'. Sob sob sob. My heart cries out to Mr B. Do you think anyone who buys a ZX80 is going to give a monkeys about that??
5) 'The ZX80 can not refresh dynamic RAM'. I'm not too hot on hardware, but I'm certain Mr B could rig up a timer circuit on a RAM board for a quid or so (no doubt that's what uncle Clive will do on any dynamic add-on).
6) 'Any traditional programmer is not likely to like the single key programming'. I've been writing programs for about six years now (I'm 20), and it's the best thing since sliced bread.
7) Yes indeed, the manual is inadequate.
8) If Sinclair brings out a printer, Mr B's ASCII troubles will be over.

Most of Henry's bit was hardware moans, but the best thing about the ZX80 took up only a part of a line... IT'S CHEAP.

Thankyou and goodbye,
Steve Dean.

7B Northfield Close,
Littlemore,
Oxford OX4 4NH.

P.S. If you ever run another competition, could you offer Tina Boylan as first prize??

Dear Sir,

I would like to thank Ian Sinclair for an invaluable series on the Mk 14, without which I, and no doubt many others would still be struggling.

Through 'messing about' on my Mk14 I have discovered a few 'pseudo ops'. Other owners may well have unburied some (or all) of them, and perhaps readers know of others they would like to contribute.

i. Having just switched on, type

0184, GO, GO

A random pattern will now appear. (See ii.)
Press

ABORT, MEM, GO

The 'Store to Tape' routine is now reading information from the display, which explains what is happening.

Can somebody explain why the least significant bit lights up when information is read FROM the display?

The number of times the dash traverses the display is controlled by changing 0FF8.

ii. Try typing in the following,

0FF9	0D
0FFA	00
0FFB	0F
0FFC	XX

Then starting from location 0FXX type in the codes for an 8 digit message, in reverse order. Type in location 0185 and 'GO'
The message is displayed.
To be fair this is not really a pseudo op, but it does allow one to display a message without having to write a program.

iii. Type in

0F02 , TERM.

For whatever byte is typed in, the equivalent pattern is displayed.
Try changing the contents of 0F0C and 0F0E.

David Brown. (16)

165 Edge Green Lane,
Golborne,
Nr. Warrington,
WA3 3XQ.

Dear Sir,

With reference to the mathematical difficulty mentioned by Elaine Douse on Page 53 of the March issue, the problem is quite easily solved by a minor modification to the statement suggested.

If it is put in the following form then for two decimal places it produces the right answer every time. If more than two decimal places are required then the figure of .001 should be altered appropriately:

x = INT((x + .001)*100)/100

As a relative beginner at computing I find your Magazine most helpful and time spent in the analysis of programs like the Home Finance one is, I find, very well spent indeed.

Yours faithfully,
Matthews & Matthews
Chartered Surveyors.

13 Princes Street,
Dorchester, Dorset.
DT1 1TW.

Dear Sir,

The April issue of Computing Today contained my description of PICO BASIC and a listing of the interpreter used to implement this language on an Mk14 to which extra RAM had been added. In its original form, however, PICO had a number of weaknesses. These became apparent after some use of the language. The three which caused most difficulty were these:

1. The method used to look at program lines was very laborious.
2. The Interpreter was stored in three separate blocks of RAM and was thus unnecessarily difficult to enter from tape.
3. There was no provision for the display of negative numbers.

These have been remedied in a new version of PICO. The new map of available RAM is as follows:

0FF7 — 0FFF	Monitor variables
0F50 — 0FF6	Serial data file
0F12 — 0F4F	PICO variables
0F00 — 0F11	Monitor variables
0B00 — 0BFF	PICO program store
0200 — 07FF	Interpreter

The interpreter now occupies 1½K of continuous RAM and can thus be entered from tape in one run of about six minutes.

The new system allows for only 28 program lines, compared with 56 previously, but in practice this has not proved to be too great a disadvantage. On the other hand there is now room for 167 2-figure numbers in the data file, compared with 77 in the old PICO, and 100 of these may be directly addressed by entering 00 to 99 in v0, giving the possibility of implementing a 10 by 10 array.

Error detection and correction is now much easier. If an error in syntax is found at run time the execution halts and the number of the faulty line is displayed. If Line is now entered the line itself is displayed. To correct it enter End followed by Input. The display is now ? and the correct line may be entered, followed by Line and End.

Anyone interested in a listing of the new PICO can contact me at the address below.

Yours sincerely,
J.G.Seal.

Greenwood Cottage,
Lower Bockhampton,
Dorchester,
Dorset DT2 8PZ.

Dear Ed.

Hi, okay, Computer games like 'Alien Invaders' and 'Startrek', 'Star Wars' are okay, but how about a game for all us Galactic Hitch-Hikers?

I've seen hikers weeping into their glasses of Janx Spirit about this inadequacy of computer games and believe me, salty Janx Spirit doesn't taste good at all say suitable for something like the Microtan 65 with expansion, or at least include a flowchart so you can play it on any machine.

I said Tangerine Microtan 65 'cos I've got one. Have the computer, once loaded introduce itself and print all commands after the phrase 'Hi there, this is Eddie your Shipboard computer' and 'I want to know I'm feeling just great guys' things like that, for the hiker's sake.

Well, surely it can't be too difficult?
Yours etc.,
Zaphod Beeblebrox's understudy,
the second greatest Guy in the universe,
Anthony John Shepherd,

Orchard Cottage,
Saville Hall Lane,
Dodworth, Barnsley,
Yorks. S75 3NG.

P.S. Your mag is the best Computer mag this side of Sirius
P.P.S. Did the man who put the Scratch button where it is on the Hewlett Packard 85 use to work for the Sirius Cybernetics Corporation?

Dear Sir,

As a result of your printing my letter in the April CT. I have found a fellow Nascom owner in Nairobi! Thankyou very much!

The answer to my question of how to CSAVE String arrays is very simple. The Nascom Microsoft BASIC does NOT distinguish between A and A$ but treats them as the same variable. This can cause unexpected program crashes, but also means that CSAVE*A will save A$ and CLOAD*A will reload it.

My Nascom 2 is now fully operational, except that it has a habit of giving errors in String functions when operating at 4MHz with a wait sate (the BASIC will not work without the wait state). These errors occur most often 15 mins. after switch-on and are eliminated after changing to 2MHz. I wonder if anyone else has experienced this, or knows a cure.

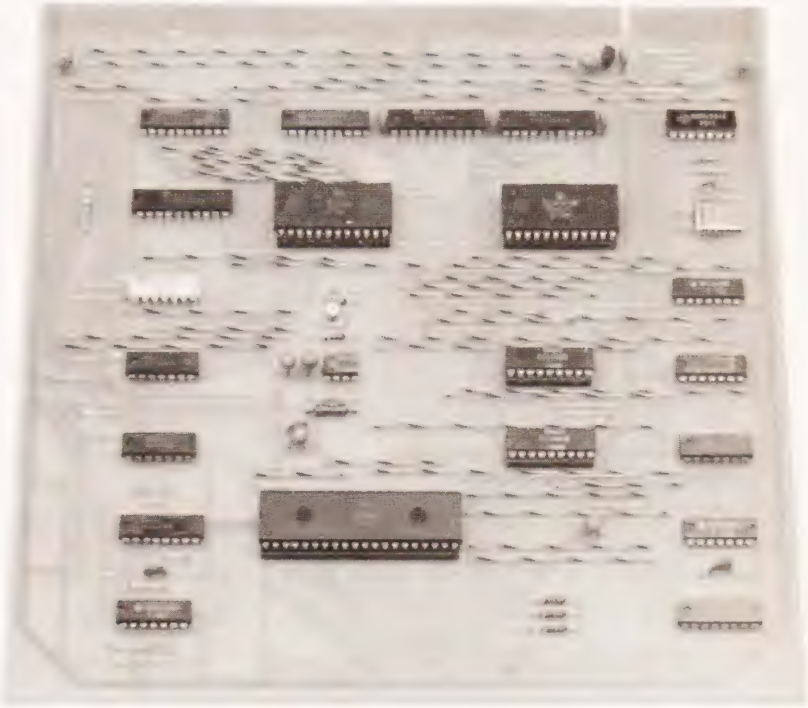
Regards,
David R. Green.

P.O. Box 50973,
Wood Ave., Nairobi,
Kenya.

P.S. It's time you did a comparative study on 'cheap' (ie under £600) matrix printers.

Mike Lord

Motorola's second generation CPU, the 6809, has been incorporated into the Newbear 77-68 system. We take a look at the Z80's strongest competitor and report on the implementation.



NewBear's 77-68 system has long been well regarded by those who like building computers as much as — or more than — using them. Starting with a 6800 based CPU board which could be operated on a stand-alone basis using switches and LEDs for I/O, a powerful microcomputer system can be built up by adding various ROM, RAM, VDU and serial or parallel I/O boards. Built on 8" square boards linked by a straightforward bus, the 77-68 system also allows the experimenter to incorporate his own ideas without difficulty, especially as NewBear will sell just the design notes, and bare printed circuit boards, as well as complete kits.

However, in the years since the 77-68 was designed, Motorola have introduced microprocessor chips that are more powerful and easier to use than the 6800. In particular, their 6809 offers a cleaner and more powerful instruction set with greatly increased throughput in most applications. To allow existing 77-68 system users to upgrade their systems, and to give new constructors a more powerful base to build on, NewBear have now released a 6809 based CPU board — the 79-09 — as an alternative to the original 6800 based card.

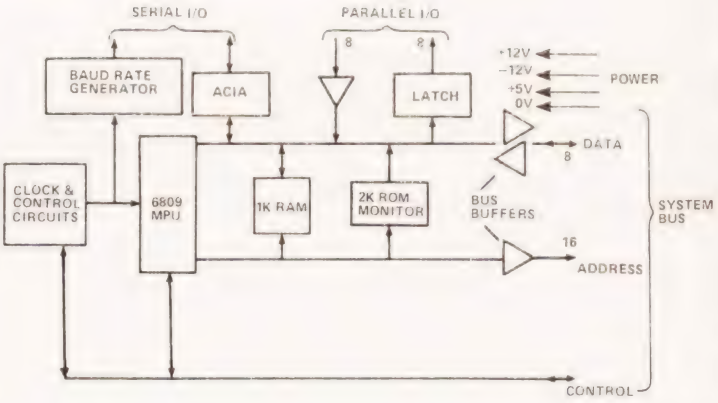


Fig.1. The block diagram of the 79-09 CPU board. It is fully compatible with all the existing range of hardware produced by Newbear for the 77-68 computer.

Design Objectives

As shown in the block diagram, the 79-09 board carries the 6909 processor itself plus 1K bytes of RAM, a 1 or 3K byte ROM monitor, separate eight bit parallel input and output ports, and a serial asynchronous I/O port for connection to a Teletype or similar terminal. It can be used as a single board computer controlled from the terminal, or a complete system may be built by using it with other boards from the 77-68 range. By using a different monitor ROM it would also be possible to manage without a terminal and instead control the board via a Hex keyboard and display connected to the parallel I/O ports. Sensibly, the ROM, RAM and I/O addresses have been made compatible with those used by South West Technical Products' 64K 6809 system, allowing the use of widely available software.

Circuit

A crystal controlled oscillator is used to provide the 6809 clock, and may be set for either a 1 or 2 uS MPU cycle time; the latter for use with cheap, slow, external memory, although this can also be catered for on a 1 uS system by using the board HOLD line to extend the MPU cycle time while slow memory is being accessed. This clock is then divided further to give a baud rate clock signal BD which can be set to any of the standard rates from 110 to 19200 baud. BD will normally be fed back into the board TX and RX CLK inputs and hence to the ACIA (Asynchronous Communications Interface Adaptor UART) and will therefore be selected to match the terminal's data rate. Serial input and output buffers connected to the ACIA give a choice of RS232 or TTL levels.

An eight bit latch X16 is used for the paralled output port, while an eight bit tri-state buffer X17

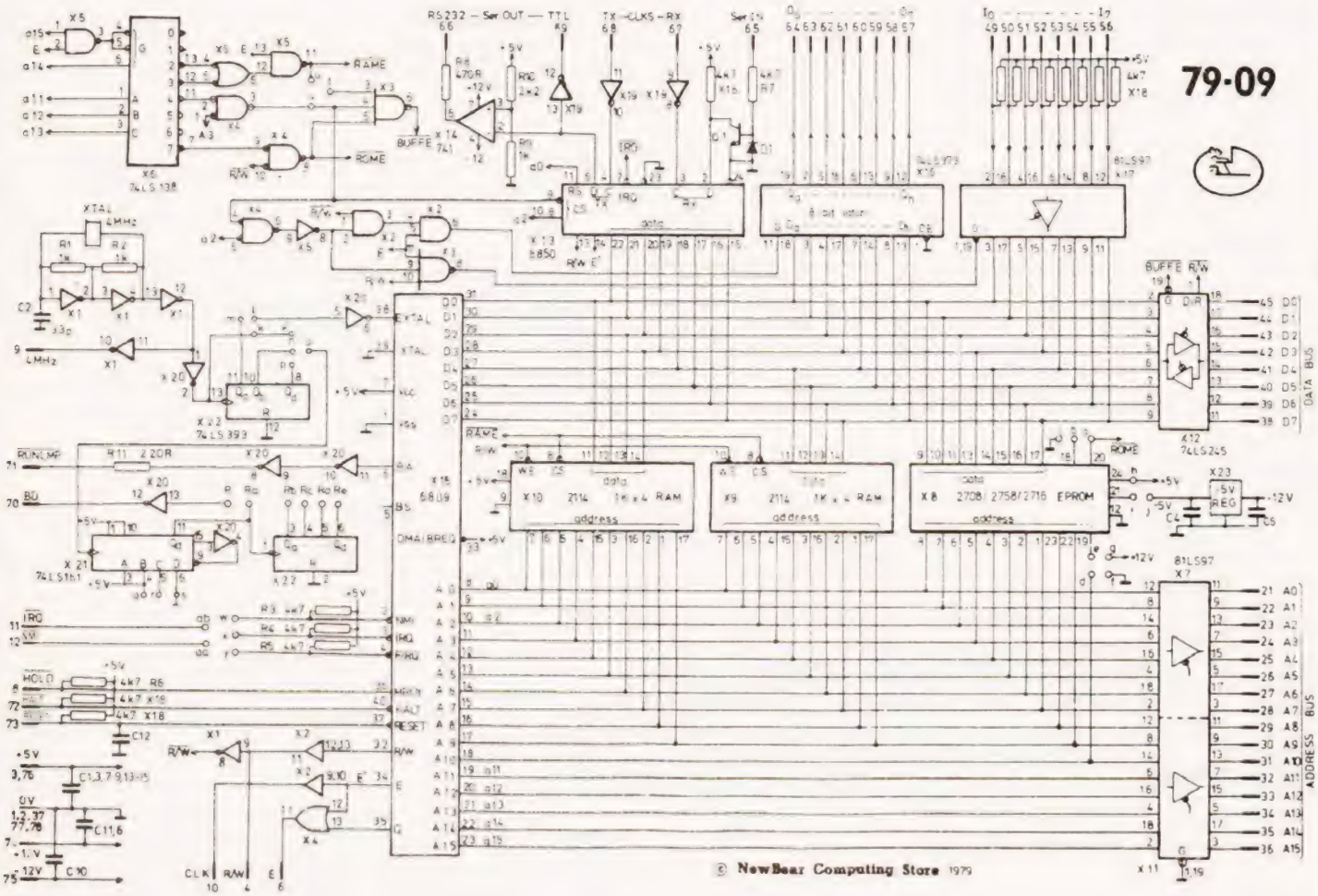


Fig.2. The circuit diagram for the new CPU card. Not that the choice of interrupt lines is via a patch as only two can be supported by the existing bus structure.

transfers information from the parallel input port onto the MPU data bus. Two 2114 1K by 4 bit static memories are used for the on-board RAM, and a 2708 or 2716 type ROM or EPROM holds the monitor program. The eight MPU data lines are buffered by a tri-state bidirectional buffer X12 for connection to the system bus, and the 16 address lines are fed through the permanently enabled buffers X7 & 11.

Address decoding for the on-board RAM, ROM and I/O ports is done by the one-out-of-eight decoder X6 and the surrounding gates such that the paralled ports are at Hex E000, the ACIA at E004/5, RAM at DC00-DFFF, and ROM occupies the top 1 or 2K of memory space. The address decoding circuits also ensure that the data bus buffer X12 is turned off when on-board memory or I/O ports are being accessed.

Although the 77-68 bus, being based on the 6800 processor, has only two interrupt lines (IRQ and NMI), the 6809 processor has a third; FIRQ (Fast Interrupt Request). Board strapping options have therefore been provided to allow the user to choose which two he extends onto the system bus.

Externally regulated +5 V and ± 12 V supplies are required, the latter for the RS232 output buffer and for certain types of EPROM. Some EPROMs also need -5 V, and this is provided by an on-board regulator.

Construction

The 79-09 uses 23 IC's including the -5 V regulator and a DIP containing 13 4k7 resistors, and these, together with the miscellaneous components, are mounted on an 8" square single sided epoxy glass PCB with gold plated edge connector pads. Using a single sided PCB has undoubtedly reduced the cost to the constructor, but means a couple of additional hours work fitting straps to the component side of the board. In all, the 79-09 can be constructed in about two evenings of careful but relaxed working. In common with other computer boards, tracks are closely spaced and construction should only be attempted by someone who is proficient in the art of soldering on crowded PCBs.

In Conclusion

The author is now spending many enjoyable hours exploring the advantages of the 6809 instruction set, and would like to thank NewBear for permission to include the 79-09 circuit and other data from their Design Note in this article.

S. Draper

ROUTE SEARCH

Route Search is a game for one player which combines luck and skill. A map, representing a railway network, is generated by the computer. At each corner or junction of the track a town (designated by either a letter or a number). Printed at the top of the screen are eleven numbers representing the number of passengers to be picked up at each town except the destination which, of course, has no passengers to be picked up.

Game Objective

The object of the game is to get as many passengers as possible to their destination (Town C) in as short a time as possible. To do this you are given three trains all of which start out at Town 2. When you wish to start a train you type the letter "A" into the computer, and then, when it asks for it, you type in the route which you wish the train to take. This is done by typing in the names of all the towns through which the train must pass before reaching Town C. (Note that Town C must end the list.)

At the end of each game the computer gives the player's score and the highest score previously scored.

Program Listing

```
000 PRINT "ROUTE SEARCH"
005 DIM S$(3), N(11), Z(3,2), P(3,2), A(12,12)
010 DIM D(3), W(3), T(3)
015 G=0
020 MAT A=ZER
025 FOR B=1 TO 11
030 A(B, B + 1)=3
035 A(B, B + 3)=2
040 A(B + 1, B)=1
045 A(B + 3, B)=4
050 NEXT B
055 A(8, 12)=2
060 A(9, 11)=2
065 A(11, 12)=1
070 A(11, 9)=4
075 A(10, 12)=3
080 FOR B=1 TO 15 STEP 2
085 POKE(33292 + B), 102
090 POKE(33692 + B), 102
095 NEXT B
100 FOR B=1 TO 11 STEP 2
105 FOR C=1 TO 16 STEP 5
110 POKE(33252 + C + B*40), 102
115 NEXT C
120 NEXT B
125 FOR B=1 TO 5 STEP 2
130 POKE(33492 + B), 102
135 POKE(33502 + B), 102
140 NEXT B
145 POKE 33292, 49
150 POKE 33492, 50
155 POKE 33692, 51
160 POKE 33258, 52
165 POKE 33499, 53
170 POKE 33738, 54
175 POKE 33263, 55
180 POKE 33502, 56
```

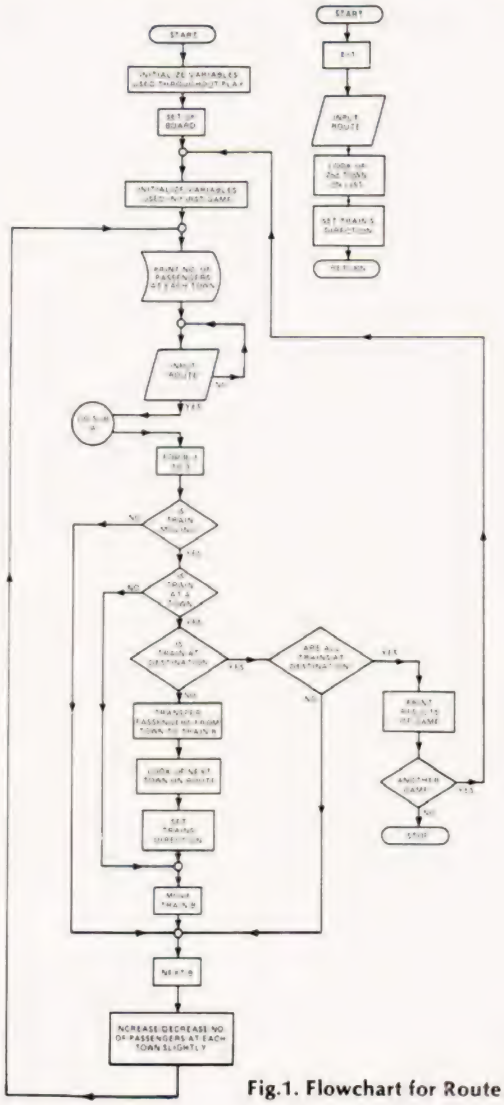


Fig.1. Flowchart for Route Search.

```
185 POKE 33743, 57
190 POKE 33309, 65
195 POKE 33509, 66
200 POKE 33709, 67
205 PRINT "(HOM)"
210 C=0, E=0, F=0, L=0, M=0
215 FOR B=1 TO 3
220 D(B)=5, W(B)=0, Z(B,1)=0, P(B,1)=0,
    Z(B,2)=5
225 P(B,2)=5, T(B)=2
230 NEXT B
235 FOR Q=1 TO 11
240 N(Q)=INT(RND(1)*120)
245 NEXT Q
250 L=L+1
255 FOR Q=1 TO 11
260 X(Q)=INT(RND(1)*1015)
265 IF N(Q)<5 THEN X(Q)=X(Q)+5
270 N(Q)=N(Q)+X(Q)
275 NEXT Q
280 PRINT "(HOM)"
285 PRINT "(CD)"
290 PRINT "(CD)"
```

```
295 PRINT "(CD)"
300 PRINT "(CD)"
305 FOR Y=1 TO 9
310 PRINT Y" - "N(Y)
315 NEXT Y
320 PRINT "A - "N(10)
325 PRINT "B - "N(11)
330 GET C$
335 IF C$="A" GOSUB 565
340 IF E=0 THEN 330
345 FOR B=1 TO 3
350 IF D(B)=5 THEN 410
355 IF W(B)=5 THEN 420
360 W(B)=W(B)+1
365 Z(B,1)=P(B,1), Z(B,2)=P(B,2)
370 ON D(B) GOTO 375, 385, 395, 405, 410
375 P(B,2)=P(B,2)-1
380 GOTO 410
385 P(B,1)=P(B,1)+1
390 GOTO 410
395 P(B,2)=P(B,2)+1
400 GOTO 410
405 P(B,1)=P(B,2)-1
410 NEXT B
415 GOTO 250
420 V$=MID$(S$(B),T(B),1)
430 GOSUB 545
435 V=VAL(V$)
440 IF V=12 THEN 480
445 T(B)=T(B)+1
450 V$=MID$(S$(B),T(B),1)
455 GOSUB 545
460 R=VAL(V$)
465 D(B)=A(V,R)
470 W=0,M=M+N(V),N(V)=0
475 GOTO 360
480 D(B)=5,C=C+1
485 IF C=3 THEN 495
490 GOTO 410
495 F=M/L
500 PRINT"YOU HAVE TAKEN "M" PASSENGERS
    TO THEIR"
505 PRINT "DESTINATION IN TIME "L
510 PRINT "THEREFORE YOU HAVE SCORED "F
515 IF F>G THEN G=F
520 PRINT "THE HIGHEST SCORE SO FAR IS "G
525 INPUT "DO YOU WANT ANOTHER GAME?"D$
530 IF D$="YES" THEN 205
540 STOP
545 IF V$="A", THEN V$="10"
550 IF V$="B", THEN V$="11"
555 IF V$="C", THEN V$="12"
560 RETURN
565 E=1, H=H+1
570 IF H>3 PRINT "SORRY, ALL ROUTES HAVE
    ALREADY BEEN";
572 PRINT "SPECIFIED"; RETURN
575 INPUT "ROUTE?"S$(H)
580 V$=MID$(S$(H),2,1)
585 V=VAL(V$)
590 D(H)=A(1,V)
595 RETURN
```

PHOTOGRAPHER'S AID

S. Richards

The following program was written for the photographic enthusiasts among us. It is an aid for the calculation of flash-to-subject distances that is needed when using an electronic flashgun. A typical example of the need for this kind of table is when doing close-up work using extension tubes or when the flash has been moved to one side to avoid "red-eye" when taking portraits.

Program Notes

The program was originally written for the Commodore PET but it should be easity adaptable to any system that uses BASIC. To avoid confusion the standard CT codes have been used for cursor and graphics characters, CD for Cursor Down etc. Enhancements can be made in the form of a continuous table printout but that is up to the individual user.

Program Listing

```
100 PRINT"[CLS]FLASH TO SUBJECT
    COMPUTER"
110 PRINT" IN PET BASIC"
120 DEF FNA(X)=INT(X*100+0.5)/100
130 PRINT"[2CD]ARE YOU USING EXTENSION
    TUBES, Y OR N ?"
140 GET A$: IF A$=" " THEN 140
150 IF A$="Y" THEN 180
160 IF A$="N" THEN 330
170 GOTO 140
180 PRINT"[2CD]ENTER FOCAL LENGTH OF
    LENS[CD]"
190 INPUT L
200 PRINT"[CD]ENTER EXTENSION[CD]"
210 INPUT E
220 PRINT"[CD]ENTER GUIDE NUMBER[CD]"
230 INPUT G
240 PRINT"[CD]ENTER INDICATED F STOP[CD]"
250 INPUT F
260 PRINT"[CD]FLASH TO SUBJECT
    DISTANCE ";
270 PRINT FNA(G*1/(((L+E)/*F)) "FEET"
290 PRINT"[2CD]PRESS ANY KEY TO RESTART"
300 GET A$:IF A$=" " THEN 300
310 GOTO 100
330 PRINT"[2CD]ENTER GUIDE NUMBER[CD]"
340 INPUT G
350 PRINT"[CD]ENTER F STOP[CD]"
360 INPUT F
370 PRINT"[CD]FLASH TO SUBJECT
    DISTANCE";
380 PRINT FNA(G/F)"FEET"
390 GOTO 290
400 END
```

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Peter Hibbs

If your fingers feel the strain from not having a 'shift lock' on your keyboard this circuit will be more than welcome.

On most computer keyboards the CONTROL and SHIFT keys have to be held depressed while one of the alpha-numeric keys is pressed at the same time. If a string of data has to be keyed in with either the CONTROL or SHIFT key operated it would be useful to be able to enter the data without having to use both hands. This circuit allows the CONTROL or SHIFT keys to be maintained in the operated condition electronically, while keying in data using the alpha-numeric keys but without disturbing the normal operation of the keyboard. A visual indication is also given when the facility is in use.

Normally, to enter a special code the CONTROL or SHIFT key is held operated while the appropriate alpha-numeric key is pressed, this method of keying a single CONTROL or SHIFT character remains unchanged. If, however, a string of shift characters is required the SHIFT key is pressed once by itself, a lamp on the keyboard lights and the shift facility remains in operation while the required alpha-numeric keys are pressed. To cancel the shift function the SHIFT key is pressed once again, the indicator lamp is extinguished and the keyboard reverts to the normal mode. the control function is identical except that a second lamp indicates that it is the control facility that is in use.

Keyboard Modification

To connect this circuit to the existing keyboard the connections to the CONTROL and SHIFT keys on the circuit board must be broken and the key contacts rewired to the two inputs of the circuit as shown in Fig.1. The two outputs of the circuit should then be connected to the existing keyboard circuitry in place of the two keys that have been disconnected. A 5V supply is required for the circuit but since the integrated circuits are CMOS types the only additional current drain is from the two light emitting diodes. the only remaining connection is a pulse signal which must go to +5V when any alpha-numeric key is pressed, normally the keyboard 'strobe' output is suitable. Two LEDs should be mounted on the front panel and labelled CONTROL and SHIFT.

Circuit Operation

The operation of the SHIFT key circuitry is described, operation of the CONTROL key circuitry is identical. The circuit consists of a bistable which can be set and reset by successive operations of the SHIFT key; the output of the bistable controls a CMOS transmission gate which performs the function of the original SHIFT key. Once the bistable has been set it can only be reset by a further operation of the SHIFT key (or the CONTROL key) and the operation of any alpha-numeric key has no effect on it. The SHIFT LED lights while the bistable is set.

Assume that the SHIFT key is pressed and released once. When the key operates the output of the Schmitt trigger gate IC3a will go high after a delay of approximately 10 mS to eliminate contact bounce. The positive-going edge at the CLK input will switch bistable IC2a to the set position and enable transmis-

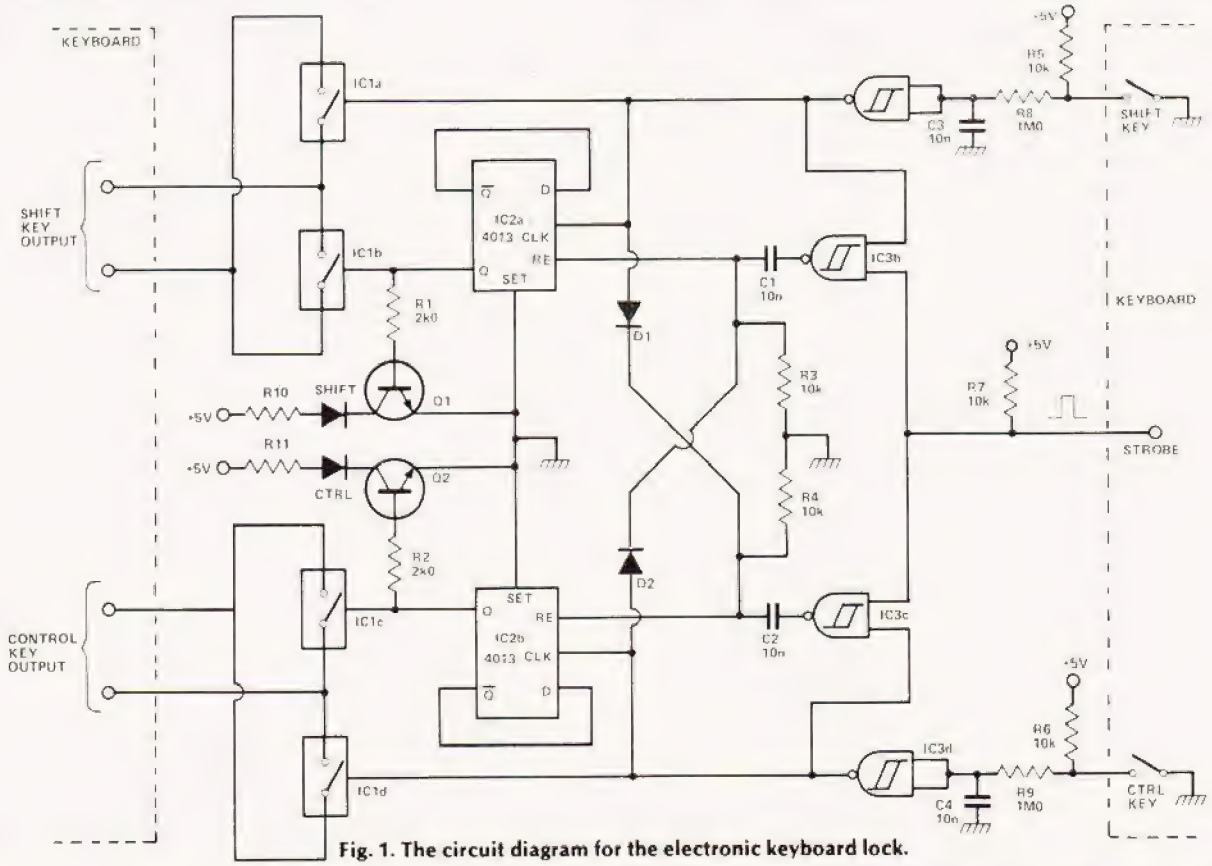

Fig. 1. The circuit diagram for the electronic keyboard lock.

KEYBOARD MINIMOD

sion gate IC1a to simulate the SHIFT function in the keyboard circuitry. The high level at the Q output of the bistable will also enable transmission gate IC1b and light the SHIFT LED via transistor Q1. The high level at the output of gate IC3a will also reset the CONTROL bistable via diode D1 if it is switched, thus preventing both bistables being set at the same time.

When the SHIFT key is released the output of gate IC3a will go low and switch off transmission gate IC1a but the bistable will remain switched to maintain the shift function via transmission gate IC1b. If the key is pressed for the second time, the positive going edge at the CLK input will restore the bistable to the reset condition because the Q output is connected back to the D input to perform a divide-by-two function. The bistable, in restoring, will extinguish the LED and remove the shift function to the keyboard by switching off the transmission gate IC1b.

If the keyboard is used in the normal way, an alpha-numeric key will be pressed while the SHIFT key is held operated. When the SHIFT key is pressed the bistable and LED will switch as before. With the SHIFT key operated the high level at the output of gate IC3a also enables an input of gate IC3b the other input of which is normally held low by the absence of any strobe pulse. If an alpha-numeric key is now also pressed this input will go high (when the strobe becomes active) so that the output of the gate IC3b will go high and this positive-going edge is transferred via capacitor C1 to the RS input of the bistable which resets to its normal state. When the SHIFT key is released, gate IC3a switches off transmission gate IC1a and the circuit is then back in its normal state.

If the CONTROL key is operated while the shift bistable is switched the high level from the output of gate IC3d will reset the bistable via diode D2.

The transmission gates used are type 4066 which have a lower 'on' resistance than the 4016 types, although either type would probably be suitable for keyboards which have high impedance inputs. If negative voltage levels are to be switched the data sheets should be consulted to ensure that the safety parameters are not exceeded.

PARTS LIST

Resistors, all ¼ W, 5%	
R1,2	2k0
R3,4,5,6,7	10k
R8,9	1M0
R10,11	To suit LEDs used
Capacitors	
C1,2,3,4	10n
Semiconductors	
IC1	4066 (4016)
IC2	4013
IC3	4093
Q1,2	BC107
D1,2	Any small silicon diode
LED 1,2	Any general purpose LED

M.C.Prior

TOWERS OF BRAHAMA

The following game is a simulation of the (supposed) project given by the supreme Hindu deity, Brahama, to his disciples. The object of the game is explained in the initial text and is not as simple as you might think from first inspection. The version of BASIC is mainframe based, it should be quite possible to convert it into lowlier dialects. The only possible points of contention are the real-time clock set at 620 and read at 1800. You will need to have good string handling capability but Integer arithmetic will suffice. As encouragement it has been converted onto a PET with no trouble at all.

Program Listing

```
100 PRINT "THE TOWER OF BRAHMA"
120 PRINT
140 PRINT "LOOKS LIKE THIS (WITH 5 RINGS):-"
160 PRINT
180 PRINT "          A          B  C"
200 PRINT "         1A1         B  C"
220 PRINT "        22A22        B  C"
240 PRINT "       333A333       B  C"
260 PRINT "      4444A4444      B  C"
280 PRINT "     55555A55555     B  C"
300 PRINT RPT (40,42)
320 PRINT NLN(1)
400 PRINT "THE OBJECT OF THE GAME IS TO
    TRANSFER THE RINGS FROM"
420 PRINT "PILLAR 'A' TO PILLAR 'C', ONE AT A
    TIME, BUT AT NO"
440 PRINT "TIME CAN A LARGER RING BE ON
    TOP OF A SMALLER RING."
460 PRINT
480 PRINT "YOU MAY REQUEST A PICTURE AT
    ANY TIME BY TYPING"
500 PRINT "'PICTURE' AS THE NEXT 'FROM'
    COMMAND."
505 PRINT
510 PRINT "TO TERMINATE TYPE 'S'."
520 PRINT
540 PRINT "HOW MANY RINGS WOULD YOU
    LIKE (5-9)? ";
550 Q=-1
560 INPUT Z
580 IF Z<5 THEN 540
600 IF Z>9 THEN 540
620 STIME (0,0,0)
640 DIM  A(3,9)
660 FOR X=1 TO 3
680 FOR Y=1 TO Z
700 IF X=1 THEN A(X,Y)=Y
720 IF X>1 THEN A(X,Y)=0
740 NEXT Y
760 NEXT X
840 PRINT "TAKE A RING FROM       ";
850 Q=Q+1
860 INPUT J$
900 J$=SEG$(J$,1,1)
910 IF J$="P" THEN 1500
920 IF J$="S" THEN 2200
940 IF J$<"A" THEN 840
960 IF J$>"C" THEN 840
980 V=ASC(J$)-64
1000 FOR Y=1 TO Z
1020 IF A(V,Y)>0 THEN T=A(V,Y) \
     A(V,Y)=0 \ GOTO 1100
1040 NEXT Y
1060 PRINT "NO RING ON THAT PILLAR"
1080 GOTO 840
1100 PRINT "TRANSFER TO       ";
1120 INPUT K$
1160 K$=SEG$(K$,1,1)
1170 IF K$="S" THEN 2200
1180 IF K$<"A" THEN 1100
1200 IF K$>"C" THEN 1100
1220 U=ASC(K$)-64
1240 FOR W=Z TO 1 STEP -1
1260 IF A(U,W)=0 THEN IF W=Z THEN A(U,W)
     =T \ GOTO 800
1280 IF A(U,W)=0 THEN IF W<Z THEN IF
     A(U,W+1)<T THEN 1340
1300 IF A(U,W)=0 THEN A(U,W)=T \ GOTO 1700
1320 NEXT W
1340 PRINT "RING ON THAT PILLAR IS
     SMALLER"
1360 A(V,Y)=T
1380 GOTO 800
1500 FOR Y=1 TO Z
1520 FOR X=1 TO 3
1540 PRINT TAB(5*X);A(X,Y);
1560 NEXT X
1580 PRINT
1600 NEXT Y
1620 PRINT TAB(5);RPT(15,42)
1640 PRINT
1660 GOTO 800
1700 FOR Y=1 TO Z
1720 IF A(3,Y)<>Y THEN 800
1740 NEXT Y
1760 PRINT "CONGRATS, YOU'VE DONE IT, & IT
     ONLY"
1780 PRINT "TOOK YOU";
1800 RTIME(H,M,S)
1820 M=M+H*60
1840 PRINT M;" MINS. & ";Q;" MOVES. "
1860 PRINT
1900 PRINT "TRY AGAIN?       ";
1920 INPUT A$
1940 IF SEG$(A$,1,1)="Y" THEN 520
1960 IF SEG$(A$,1,1)<>"N" THEN 1900
1980 PRINT "OK, BYE"
2000 STOP
2200 PRINT "PITY, SO FAR IT ";
2220 GOTO 1780
```

```
        THE TOWER OF BRAHMA
LOOKS LIKE THIS(WITH 5 RINGS) :-

          A           B           C
         1A1          B           C
        22A22         B           C
       333A333        B           C
      4444A4444       B           C
     55555A55555      B           C
**********************************
THE OBJECT OF THE GAME IS TO
TRANSFER THE RINGS FROM PILLAR 'A'
TO PILLAR 'C', ONE AT A TIME, BUT
AT NO TIME CAN A LARGER RING
BE ON TOP OF A SMALLER RING.

YOU MAY REQUEST A PICTURE AT ANY
TIME BY TYPING 'PICTURE' AS THE
NEXT 'FROM' COMMAND.
TO TERMINATE TYPE 'S'.

HOW MANY RINGS WOULD YOU
LIKE(5-9)?    6

TAKE A RING FROM      A
TRANSFER TO      B
TAKE A RING FROM      A
TRANSFER TO      C
TAKE A RING FROM      B
TRANSFER TO      C
TAKE A RING FROM      PIC
      0    0    0
      0    0    0
      3    0    0
      4    0    0
      5    0    1
      6    0    2
     ***************

TAKE A RING FROM      A
TRANSFER TO      B
TAKE A RING FROM      C
TRANSFER TO      A
TAKE A RING FROM      C
TRANSFER TO      A
RING ON THAT PILLAR IS SMALLER
TAKE A RING FROM      PIC
      0    0    0
      0    0    0
      1    0    0
      4    0    0
      5    0    0
      6    3    2
     ***************

TAKE A RING FROM      C
TRANSFER TO      B
TAKE A RING FROM      A
TRANSFER TO      B
TAKE A RING FROM      C
NO RING ON THAT PILLAR
TAKE A RING FROM      PIC
      0    0    0
      0    0    0
      0    0    0
      4    1    0
      5    2    0
      6    3    0
     ***************

TAKE A RING FROM      A
TRANSFER TO      C
TAKE A RING FROM      B
TRANSFER TO      C
TAKE A RING FROM      B
TRANSFER TO      A
TAKE A RING FROM      C
TRANSFER TO      A
TAKE A RING FROM      PIC
      0    0    0
      0    0    0
      1    0    0
      2    0    0
      5    0    0
      6    3    4
     ***************

TAKE A RING FROM      B
TRANSFER TO      C
TAKE A RING FROM      A
TRANSFER TO      B
TAKE A RING FROM      A
TRANSFER TO      C
TAKE A RING FROM      PIC
      0    0    0
      0    0    0
      0    0    0
      0    0    2
      5    0    3
      6    1    4
     ***************

TAKE A RING FROM      STOP
PITY, SO FAR IT TOOK YOU
2  MINS. &  21  MOVES.

TRY AGAIN?    NO
O.K.  BYE
```

A sample game of 'Towers' played on a mainframe system.

INSTANT SOFTWARE

TRS 80 Level 1

BUSINESS PACKAGE I Keep the books for a small business with your TRS-80 Level 1 4K. The six programs included are:

General Information — The instructions for using the package.

Fixed Asset Control — This will give you a list of your fixed assets and term depreciation.

Detail Input — This program lets you create and record your general ledger on tape for fast access.

Month and Year to Date Merge — This program will take your monthly ledger data and give you a year to date ledger.

Profit and Loss — With this program you can quickly get trial balance and profit and loss statements.

Year End Balance — This program will combine all your data from the profit and loss statements into a year end balance sheet.

With this package, you can make your TRS-80 a working partner. **Order No. 0013R**

PERSONAL FINANCE I Let your TRS-80 handle all the tedious details the next time you figure your finances:

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SANTA PARAVIA AND FIUMACCIO Become the ruler of a medieval city-state as you struggle to create a kingdom. Up to six players can compete to see who will become the King or Queen first. This program requires a 16K TRS-80 Level 1 & 2.**Order No. 0043R**

ELECTRONICS I This package will not only calculate the component values for you, but will also draw a schematic diagram, too. You'll need a TRS-80 Level 1 4K or Level 2 16K to use:

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This package will reduce your designing time and let you build those circuits fast. **Order No. 0008R**

HAM PACKAGE I This versatile package lets you solve many of the commonly encountered problems in electronics design. With your Level 1 4K or Level 2 16K TRS-80, you have a choice of:

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Dipole and Yagi Antennas — Design antennas easily, without tedious calculations.

This is the perfect package for any ham or technician. **Order No. 0007R**

Level 2

CARDS This one-player package will let you play cards with your TRS-80 — talk about a poker face!

Draw and Stud Poker — These two programs will keep your game sharp.

No-Trump Bridge — Play this popular game with your computer and develop your strategy.

This package's name says it all. Requires a TRS-80 Level 2 16K. **Order No. 0063R**

HOUSEHOLD ACCOUNTANT Let your TRS-80 help you out with many of your daily household calculations. Save time and money with these fine programs:

Budget and Expense Analysis — You can change budgetting into a more pleasant job with this program.

Life Insurance Cost Comparison — Compare the cost of various life insurance policies. Find out the difference in price between term and whole life.

Datebook — Record all those important dates in your life for fast, easy access. The program has all major holidays already included.

All you need is TRS-80 Level 2 16K. **Order No. 0069R**

FINANCIAL ASSISTANT Let the TRS-80 help you with Investments, Loans, Personal Finances and Forecasting. Will run on a 4 or 16K Level 2 machine. **Order No. 0072R**

PET

CASINO I These two programs are so good, you can use them to check out and debug your own system!

Roulette — Pick your number and place your bet with the computer version of this casino game. For one player.

Blackjack — Try out this version of the popular card game before you go out and risk your money on your own "surefire" system.

This package requires a PET with 8K. **Order No. 0014P**

CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but also will teach you how to play the odds and make the best bets. A one player game, it requires a PET 8K. **Order No. 0015P**

CHECKERS/BACCARAT Play two old favourites with your PET.

Checkers — Let your PET be your ever-ready opponent in this computer-based checkers program.

Baccarat — You have both Casino- and Blackjack-style games in this realistic program.

Your PET with 8K will offer challenging play anytime you want. **Order No. 0022P**

MIMIC Test your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. **Order No. 0039P**

TREK-X Command the Enterprise as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. **Order No. 0032P**

TURF AND TARGET Whether on the field or in the air, you'll have fun with Turf and Target package. Included are:

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Target — Use the numeric keypad to shoot your puck into the home position as fast as you can.

To run and score all you'll need is a PET with 8K. **Order No. 0097P**

ARCADE I This package combines an exciting outdoors sport with one of America's most popular indoor sports:

Kite Fight — It's a national sport in India.

Pinball — By far the finest use of the PET's exceptional graphics capabilities we've ever seen, and a heck of a lot of fun to play to boot.

Requires an 8K PET. **Order No. 0074P**

ARCADE II One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:

UFO — Catch the elusive UFO before it hits the ground!

Hit — Better than a skeet shoot. The target remains stationary, but you're moving all over the place.

Blockade — A two-player game that combines strategy and fast reflexes.

Requires 8K PET. **Order No. 0045P**

DUNGEON OF DEATH Battle evil demons, cast magic spells, and accummulate great wealth as you search for the Holy Grail. You'll have to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. **Order No. 0064P**

Apple

MATH TUTOR I Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:

Hanging — Perfect your skill with decimal numbers while you try to cheat the hangman.

Spellbinder — Cast spells against a competing magician as you practice working with fractions.

Whole Space — While you exercise your skill at using whole numbers your ship attacks the enemy planet and destroys alien spacecraft.

All programs have varying levels of difficulty. All you need is Applesoft II with your Apple and 24K. **Order No. 0073A**

MATH TUTOR II Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:

Car Jump — Reinforce the concept of calculating area while having fun making your car jump over the ramps.

Robot Duel — Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.

Sub Attack — Take the mystery out of working with percentages as your submarine sneaks into the harbour and destroys the enemy fleet.

All you need is Applesoft II with your Apple and 20K. **Order No. 0098A**

GOLF Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel your game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. **Order No. 0018A**

BOWLING/TRILOGY Enjoy two of America's favourite games transformed into programs for your Apple:

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SYSTEMATIC PROGRAMMING

Brian Gilbert

A guide to the art of successful programming techniques.

Whilst it is quite possible to sit at a terminal, or one's personal computer, and write programs the proof of the pudding (or the programmer's equivalent) is in the running. Do you sometimes find that your 'perfect' program, which you had always thought bug-proof, ups and dies all over the place!

If you have ever found yourself in this position then you should read on. An absolute cure is certainly not quaranteed but the very admission that your highly prized software may not be as good as you thought can only open your eyes to the dangers that lurk. Become a systematic programmer and save yourself wasted hours, after all you can use them to play that 64K Star-trek you were thinking of coding up when you spotted this article!

Stages In Programming

Your program may be part of a system in which case the System Designer should provide you with the initial documentation otherwise you must create it yourself. The initial documentation should consist of

1. Program Description. An outline of the purpose of the program in a few lines followed by a detailed description in plain language that the user can understand and confirm as meeting his requirements.
2. A diagram showing the program with its input and output files. This gives the reader a quick picture into which the detail can be fitted.
3. Copies of the File Specs.
4. Copies of the Record Layouts.
5. Copies of the Print Charts and Screen Layouts.

You should be able to commence programming in the belief that there are no questions that need answering to complete the program. Life is not like that of course, Questions will often arise but the sooner they are handled the better and it is asking for trouble to continue when you know they exist.

Flowcharting Simple Programs

Take a sheet of plain A4 paper and start in the top left hand corner, with the terminal symbol. Go downwards and in the appropriate symbol put the first step mentioned in the detailed description. If it was a question with more than one answer then the symbol will have more than one exit line. Carry on down with the first alternative and do the next symbol with its content. Eventually this path will either loop back or reach the end. What else can it do? Now return to the first path you left in mid-aid and finish that one, and so on till all loose ends have been handled. The finer points are expanded upon later but for the moment you have reduced the plain language description to a series of statements that you know can be coded using the GOTO statement to link any blocks which do not follow consecutively in the coding. You can code them from top to bottom, left to right without further concern about the order other than that.

Now you can think about the program in terms of the flowchart which is easier than in terms of the coding which, in most cases, constitutes unnecessary detail. If you ever have to modify it then modify the flowchart before the coding.

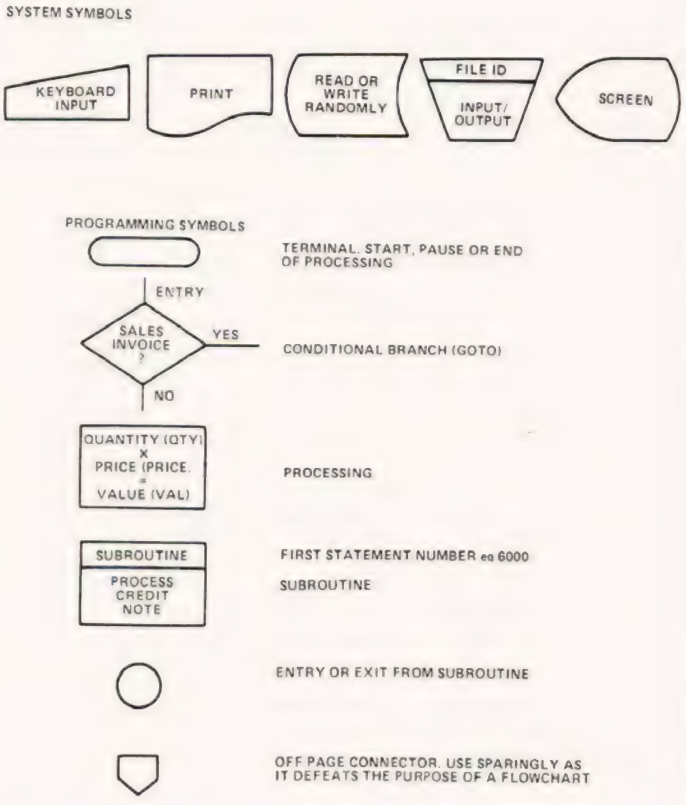


Fig 1. Some typical flowcharting symbols and their uses.

Coding

Write out the coding. Think about it as you do it. On your flowchart you should pencil in corresponding statement numbers. Start a new block in the thousands for every page and leave large gaps where you anticipate change. Remember to go from top to bottom, left to right as you number the blocks. Now code each block as a group of statements, the first one having the statement number penciled in above the block.

As each new Variable is used add it to a list of variables. (see Table 1) Finally you can key in the coding.

XM	Random Number in range −1,0,+1 controlling horiontal movement of "Brush".
YM	Ditto for vertical movement
X	X axis coordinate for drawing border
Y	Y axis for coordinate for drawing border
XP	X axis coordinate for adding point to picture
YP	Y axis coordinate for adding point to picture
TR	Number of tries to find an unfilled adjacent point to "Brush".
P	Counter for pause timing
PI	Count of pictures drawn

Table 1. The variable list for MATISSE

Sightchecking
List the program as keyed in without attempting to run it. If you haven't got a printer then work from the screen. Check all the coding against the flowchart and print charts etc. Do *not* check against coding sheets as this does not pick up your coding errors.

Do not attempt to run the program as you will be tempted to fix only the obvious errors. Little used parts of the program can hide bugs for a very long time.

Test Description And Test
Write down what each test "shot" is to test, what is to be fed in and the anticipated results. You will begin to realise, maybe for the first time, that it is often impossible to test all possible permutations and combinations. That is why you need a sound approach which minimizes the number of errors or at least one of the reasons. You should exercise each statement at least once and feel that if and when undiscovered errors show up they are not likely to cost more effort than is needed to find them now.

If the program is part of a system then the System Designer should also have provided test data which merely tests that it will work *if the rest of the system works properly*. You should now check for any data which could crash your program due to an external error. For example, the System Designer may say a field will never be zero. You should still test it for zero if you are going to divide with it, and report via a message or error code if it is zero. If the computer knows why it can't handle something then make it give a message to the user, not just smirk!

Test, Test And Test Again
Run the test and have someone else check the results. If it is a game then get a lot of people to play it. As you check each stage you should go over the preceding stage in your mind. It is very likely that you will learn something that makes you feel you could improve significantly on something and want to go back and do so. Don't be afraid to do it, that's the way to improve fast. Just remember to review the subsequent work as well and revise where necessary

An Example
Program Name: MATISSE (After the French painter.)
Outline: A seemingly original picture is drawn, consisting basically of straight lines. To the casual observer the lines are neither random nor part of a rigid pattern, leaving him to wonder whether if drawn by a person it would be accepted as art

Fig 2. A specimen I/O diagram. Although it is almost too trivial for our example program it is worth drawing when you are tackling larger problems.

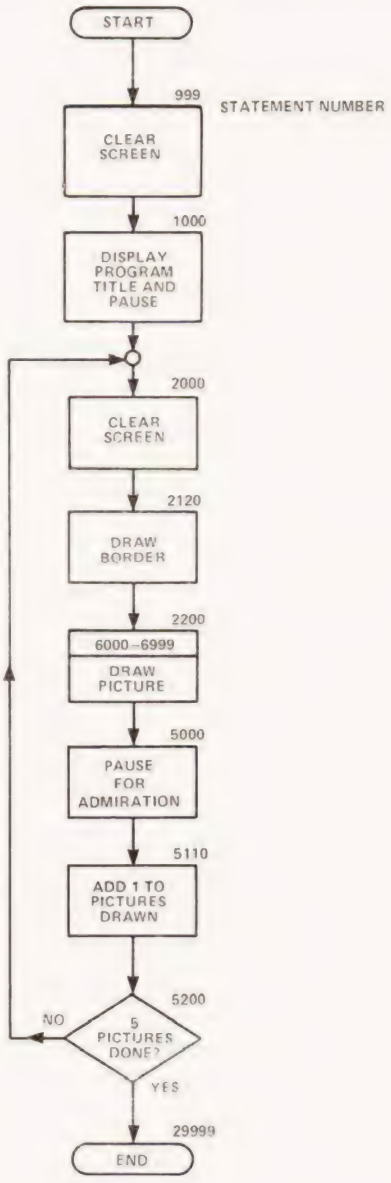


Fig 3. The main routines for the MATISSE program.

Detail: The screen is cleared and the program title is displayed. The user is invited to "Press Enter To Continue". When he does so the screen is again cleared. A border is drawn round the sides of the screen. A point appears at a random location within the border. Another point appears above it, or below it or at an angle of 45 degrees. They are adjacent and so form a line. The line is extended in the original direction until it reaches the border or an existing point. At this time the line takes a new direction if all surrounding points are not occupied. If they are occupied then there is a pause to give the user time to admire the picture. The screen is then cleared an a fresh picture drawn until five pictures have been displayed. The program then ends.

The fascination of the program lies in the user's attempts to forecast how long the drawing of the picture will continue before it ends.

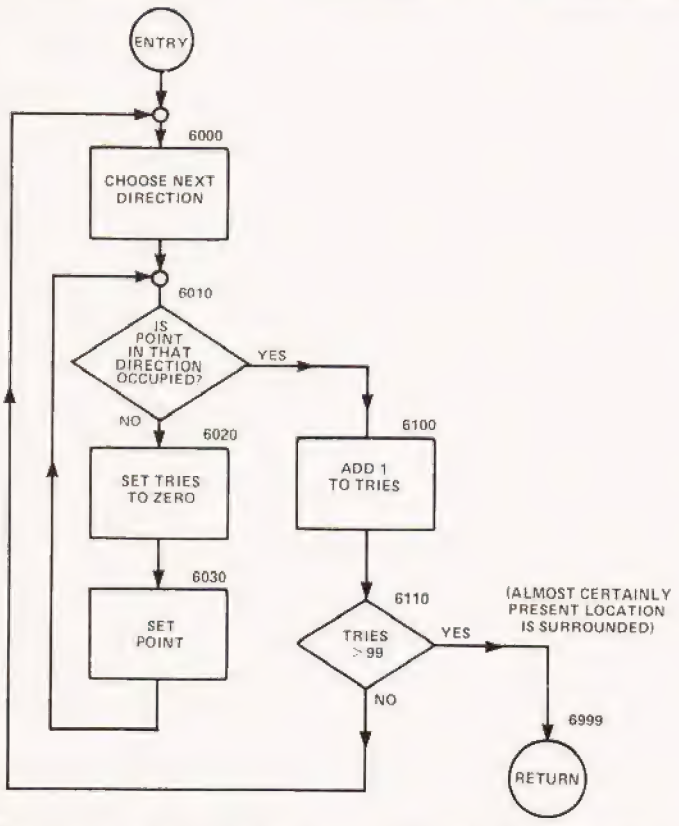
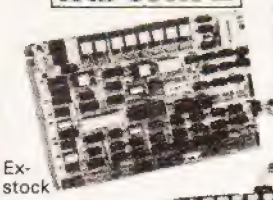


Fig 4. The subroutine to draw one picture from the MATISSE program.

```
 0999 CLS
 1000 PRINT"MATISSE VERSION 110"
 1010 PRINT "WRITTEN BY BRIAN GILBERT"
 1020 PRINT "21ST APRIL 1980"
 1030 REM FOR TRS80
 1040 INPUT "PRESS ENTER TO CONTINUE";A
 2000 CLS
 2120 FOR X=0 TO 127: FOR Y=0 TO 47 STEP 47:
      SET(X,Y)
 2125 NEXT Y: NEXT X

 2130 FOR Y=0 TO 47: FOR X=0 TO 127 STEP 127:
      SET(X,Y)
 2135 NEXT X: NEXT Y
 2140 XP=RND(125) +1:YP=RND(45) +1
 2200 GOSUB 6000

 5000 FOR P=1 TO 1000: NEXT P
 5100 REM
 5110 PI=PI+1
 5200 IF PI=5 THEN GOTO 29999 ELSE GOTO 2000

 6000 XM=RND(3)-2:YM=RND(3)-2
 6010 IF POINT((XP+XM),(YP+YM))
      THEN GOTO 6100 ELSE GOTO 6020
 6020 TR=0
 6030 XP=XP+XM:YP=YP+YM
 6040 SET(XP,YP): GOTO 6010
 6100 TR=TR+1
 6110 IF TR>99 THEN GOTO 6990 ELSE GOTO 6000
 6999 RETURN
29999 STOP: GOTO 1000
```

Fig 5. The program listing of MATISSE.

nascom-2 MICRO-COMPUTER



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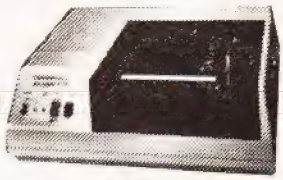

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Graham Hardy

PEA GAME

This game is an implementation in BASIC of the old "Pea under a cup" guessing game. Written for the Research Machines 380Z it can be adapted for most systems. The rules of the game are included in the listing between lines 620 and 720 and may be removed if required.

Program Explanation

The operation of the program is as follows; lines 200-330 plot the three "cups" on the screen, the data is stored in 300, 310 and the number plotting is contained in 330.

Having plotted the cups a pea, asterisk symbol, is plotted under one of the cups and then erased. After a delay, set by the value input in lines 170-190, the pea is re-plotted under another cup in a random fashion. This continues for a random number of moves, the routine is located in 350-440.

You are then asked to guess where the pea is, 450-490 and told if your answer is correct. The whole process is repeated twice and a final score is given with comments as to your ability, lines 510 to 560.

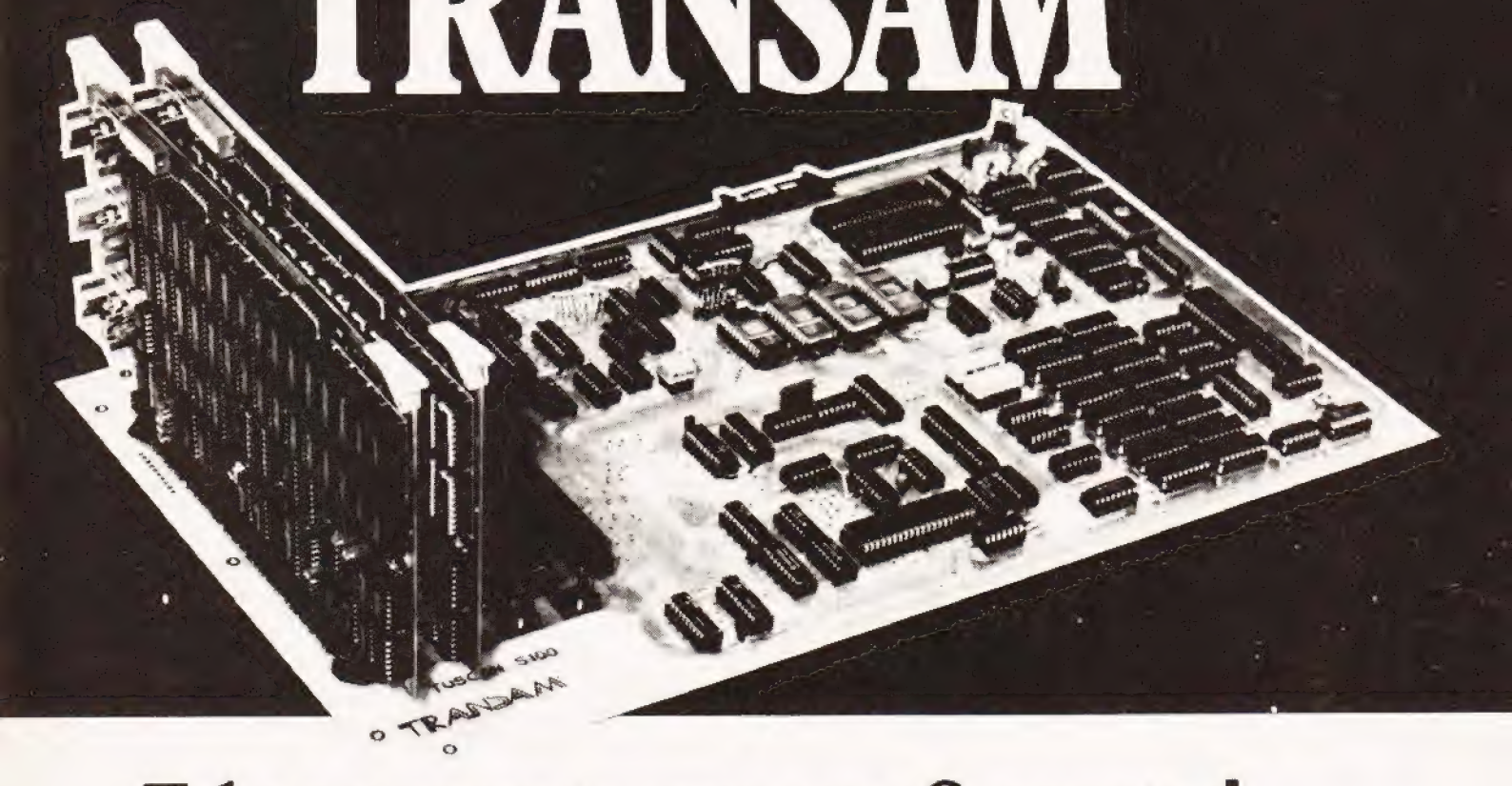
It should be noted that the following commands are probably unique to the RML BASIC and will need to be changed when transferred to other systems; CLS is, as usual, the clear screen code (CHR$ (12) for the 380Z, GRAPH 1 sets the screen for scrolling on the bottom four lines only, GRAPH 0 sets the screen to normal, scrolling mode, PLOT X,Y,2 will plot a small white square at the X,Y, co-ordinate.

Program Listing

```
100 REM *** THE PEA GAME ***
110 CLEAR 100
120 PRINT [CLS]
130 INPUT"WOULD YOU LIKE INSTRUCTIONS";
    A$
140 IF A$="YES" OR A$="Y" THEN 610
150 IF A$="NO" OR A$="N" THEN 170
160 PRINT"ANSWER PROPERLY":GOTO 130
170 INPUT "DIFFICULTY LEVEL(1-10)";DL
180 IF DL>10 OR DL<1 THEN DL=10
190 DL=INT((11-DL)*20)
200 REM *** PLOT UP BELLS ***
210 PRINT [CLS]:GRAPH 1
220 FOR B=13 TO 45 STEP 16
230 FOR A=1 TO 32
240 READ X,Y
250 PLOT X+B,Y+20,2
260 NEXT A
270 RESTORE
280 NEXT B
290 PLOT 20,35,49:PLOT 36,35,50:PLOT
    52,35,51
300 REM *** DATA FOR PLOTTING BELLS ***
310 DATA 1,1,2,1,2,2,3,3,3,4,3,5,3,6,3,7,3,8,
    3,9,4,10,4,11,5,12,6,13,7,13,8,13,9,13
320 DATA 10,12,11,11,11,10,12,9,12,8,12,7,
    12,6,12,5,12,4,12,3,13,2,13,1,14,1,1,1,
    1,1,1,1
330 PLOT 20,35,49:PLOT 36,35,50:PLOT
    52,35,51
340 PRINT"WATCH CLOSELY":FOR Z=1 TO
    750:NEXT Z
350 FOR F=1 TO INT(RND(1)*20+20)
360 REM *** WORK OUT PEA POSITION ***
370 C=INT(RND(1)*3+1)
380 REM *** PLOT PEA ***
390 PLOT C*16+4,22,42
400 REM *** ERASE PEA ***
410 PLOT C*16+4,22,32
420 REM *** DELAY LOOP ***
430 FOR E=1 TO DL:NEXT E
440 NEXT F
450 REM *** WHERE IS THE PEA ? ***
460 INPUT"WHERE'S THE PEA";I
470 IF I=C THEN W=W+1:? "LUCKY GUESS":
    GOTO 490
480 PRINT"HARD LUCK"
490 H=H+1:IF H<3 THEN 340
500 REM *** THE GAME IS OVER ***
510 ON W+1 GOTO 520,530,540,550
520 PRINT"HARD LUCK ";:GOTO 560
530 PRINT"OH WELL!! ";:GOTO 560
540 PRINT"NOT BAD ";:GOTO 560
550 PRINT"WELL DONE ";
560 PRINT"YOU SCORED";W;"OUT OF 3"
570 INPUT"ANOTHER GAME";A$
580 IF A$="YES" OR A$E"Y" THEN RUN
590 END
600 REM *** INSTRUCTIONS ***
610 GRAPH 0:PRINT[CLS]
620 PRINT"YOU MUST FIRST STATE THE LEVEL
    OF"
630 PRINT"DIFFICULTY THAT YOU WOULD LIKE
    TO"
640 PRINT"PLAY TO, IN THE RANGE OF 1 TO
    10."
650 PRINT
660 PRINT"THEN 3 'BELLS' WILL APPEAR ON
    THE"
670 PRINT"SCREEN AND A 'PEA', WHICH IS
    SHOWN"
680 PRINT"BY *, WILL MOVE RANDOMLY
    BETWEEN"
690 PRINT"THEM."
700 PRINT
710 PRINT"WHEN THE PEA HAS STOPPED
    MOVING"
720 PRINT"AND HAS DISAPPEARED, YOU MUST
    SAY"
730 PRINT:PRINT:PRINT
740 INPUT "HIT 'RETURN' TO CONTINUE";A$
750 GOTO 170
```

"Pea Game" Program written in RML BASIC, users of other systems should refer to the text for notes on the conversions needed.

'TUSCAN' FROM TRANSAM



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MULTIPURPOSE RECORDS

A P Stephenson

Computers were meant to handle information and this program lets them do it in any environment, from the business to the home.

Home computing as a hobby is still in its infancy and it is understandable that programming activities tend to exploit the more exciting capabilities of the computer. The compilation and processing of "records" is unfortunately a subject lacking in glamour and, apart from their use in commerce and business, remains a neglected area. There are of course commercial software houses that churn out excellent suites of programs which cater for the businessman but, from the small system users' viewpoint, they tend to suffer from high cost and inevitably require some form of disk backing store to cater for the vociferous appetites of the modern Accountants. At a guess, it is doubtful if more than one in twenty owners of a microcomputer have sufficiently recovered from the trauma of its initial purchase to even consider further expenditure on the floppy! Commercial software also assumes that facilities for hard copy output are available and refuses to cater for the underprivileged classes who don't have a printer. Thus the combination of cost, and lack of glamour has caused most enthusiasts to neglect the records area altogether. Now this is a pity. The ability of a computer to store, retrieve, select, modify and rearrange data is its most endearing quality.

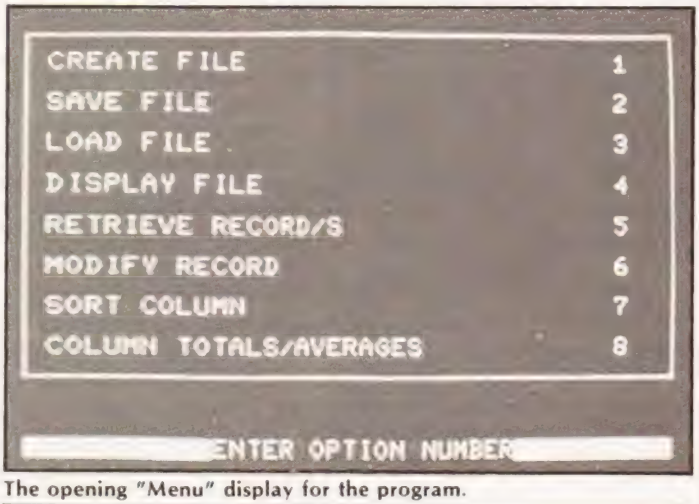
Terminology Defined

A few terms need to be defined before programs can be understood. A FILE is a collection of information on one subject; for example, a file name could be "Clients Credit-worthiness" or "Lepidoptera" or "Power Transistors", "World Religions" etc., etc. Files are normally displayed as a number of rows and columns. A RECORD is any individual ROW and a DATA-ITEM is any individual column in that row.

The minimum requirements of any program which assumes the title of General Purpose Records must allow the following options:

a) *Create a new file* by naming the column headings and entering the records from the keyboard.
b) *Save the file* on backing store under an appropriate file name.
c) *Load a file* from backing store.
d) *Display the contents* on the screen, page by page.
e) *Retrieve a selected record or records* on inputting a "search key"
f) *Modify* a selected record
g) *Sort* the order in which the records are arranged under a selected column heading.
h) *Calculate* the sum, averages etc of the columns (where applicable).

This program attempts to satisfy the minimum requirements and subject to the limitations imposed by small memory, will just squeeze itself into an 8K PET providing the number of rows (size of the file) is kept to a modest level. With a 16K PET there is ample room for the display and processing of several hundred records and apart from the slowness of cassette tape access, will satisfy a practical need.



The opening "Menu" display for the program.

Programming Notation

To get over the problems of not being able to reproduce the graphics characters produced by PET the following symbol code is used.

[CD]	Cursor down
[CL]	Cursor left
[CR]	Cursor right
[CU]	Cursor up
[CLS]	Clear screen
[HOM]	Home
[REV]	Reverse video on
[OFF]	Reverse video off
[SPC]	Space character

In addition to these codes a number of graphics are used for screen display purposes and these are represented by a number showing the number used followed by an up arrow sign and the key code which produces them. An example would be [38↑#] which produces a line of horizontal bars at the top of each character space. For those of you with machines other than PETs it is really a matter of cosmetic appeal, anything found inside square brackets is a cursor or graphics code and can be ignored until the end of inputting the program.

Visual Restriction

Unfortunately, the PET screen is only 40 characters wide which restricts the number of columns in a record to about four. Even then, the column headings must be entered with restraints on the number of characters. A relatively wide field has been allowed for column one because this is normally the key to the record, such as the name of a person, animal, insect or object. If a data item is considered long the program warns of this but accepts it. Data is held in the string array A (R,C) and is dimensioned in line 10 as (100,5) which allows for a nominal 100 rows and 5 columns. For 8K models, the dimensioning is too ambitious and will need reducing to say 25,5 in order to avoid that awful "'OUT OF MEMORY ERROR". For 16K PETs on the other hand, the dimensions are too modest and can be increased to over 200 rows if desired.

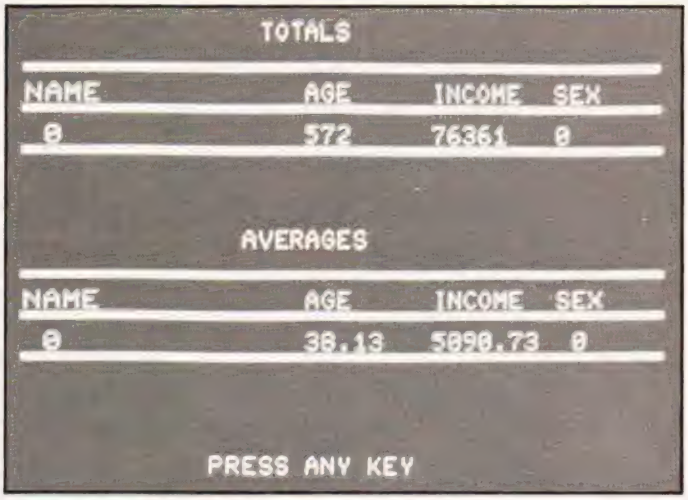
File Creation

When an operator creates a file it is essential to guard against the inadvertent pressing of the RETURN key before hitting a data key. The subroutine at line 2380 prevents this on *all* INPUT statements. The option entitled "SORT COLUMN" employs a simple bubble sort and is rather slow for long records but the extra statements for the faster merge sort would encroach on the 8K memory capacity still further. It will be appreciated that sorting records into some order is not a simple case of sorting a column. When a swop is necessary, every data item in the record must take part in the swop which complicates the process. Owners of 16K models can change the bubble to a merge sort if they find the slowness irksome.

The option "RETRIEVE RECORD/S" allows an operator to selectively display all records which fall into a required catagory. Thus if one of the column headings is "AGE", we may ask for a display of all personnel of age 23. If, by chance, nobody in the file is of that age the message "RECORD NOT ON FILE" is given.

Files are stored on a "DATA" tape and the relevent patching routines to compensate for the 'early' ROM bugs are included in the program. It is possible to obtain further copies of a data tape by first loading in the tape by the option "LOAD FILE" and then using "SAVE FILE" with a blank tape. Because file creation is error prone provision exists for modifying at the end of each record and, again when the file is complete by using the option "MODIFY FILE". Once a file is complete, it can be displayed a page at a time without scrolling.

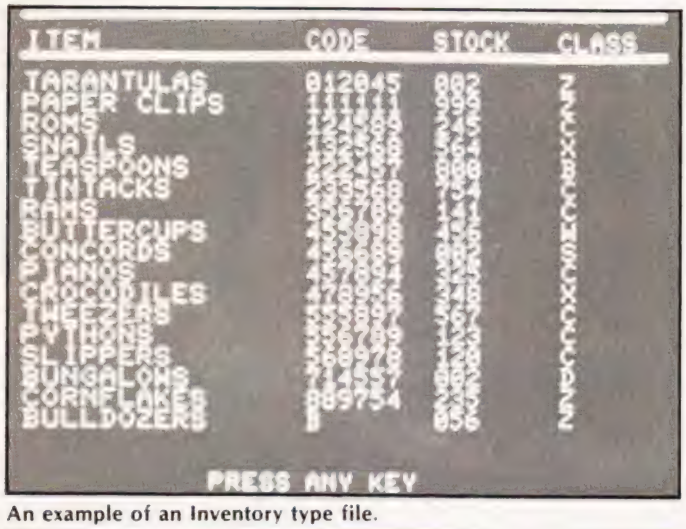
```
100 DIM A$(100,5)
110 PRINT CHR$(147)
120 PRINT"[↑0] [38↑#] [↑P]"
130 PRINT"[↑%] CREATE FILE [23 SPC] 1 [↑]"
140 PRINT"[↑%] [38 SPC] [↑']"
150 PRINT"[↑%] SAVE FILE [25 SPC] 2 [↑']"
160 PRINT"[↑%] [38 SPC] [↑]"
170 PRINT"[↑%] LOAD FILE [25 SPC] 3 [↑']"
180 PRINT"[↑%] [38 SPC] [↑']"
190 PRINT"[↑%] DISPLAY FILE [22 SPC] 4 [↑]"
200 PRINT"[↑%] [38 SPC] [↑']"
210 PRINT"[↑%] RETRIEVE RECORD/S [17 SPC]
    5 [↑']"
220 PRINT"[↑%] [38 SPC] [↑P]"
230 PRINT"[↑%] MODIFY RECORD [21 SPC] 6
    [↑]"
240 PRINT"[↑%] [38 SPC] [↑']"
250 PRINT"[↑%] SORT COLUMN [23 SPC] 7 [↑']"
260 PRINT"[↑%] [38SPC] [↑P]"
270 PRINT"[↑%] COLUMN TOTALS/AVERAGES
    [12 SPC] 8 [↑]"
280 PRINT"[↑L] [38 ↑$] [↑:]":PRINT:PRINT:PRINT
290 PRINT"[REV] ENTER OPTION NUMBER"
300 GET K$:IF K$=" " THEN 300
310 E$="INPUT UNACCEPTABLE"
320 IF VAL(K$)<1 OR VAL(K$)>8 THEN PRINT
    E$:PRINT:PRINT:PRINT:GOTO 290
330 ON VAL(K$) GOTO 340,680,980,1780,
    1830,2180,1250,1500
```



Using the calculation option on an employee file.

```
340 REM**INPUT LIMITS
350 R$="LIMIT IS 100!":C$="LIMIT IS 4!"
360 PRINT CHR$(147):PRINT TAB(240)
370 PRINT"HOW MANY RECORDS?" ;TAB(25);:
    GOSUB 2380
380 PRINT:Y=VAL(A$(R,C)):PRINT
390 IF Y<1 OR Y>100 THEN PRINT R$:PRINT:
    PRINT:GOTO 370
400 PRINT"HOW MANY COLUMNS?";TAB(25);:
    GOSUB 2380
410 PRINT:X=VAL(A$(R,C)):PRINT
420 IF X<1 OR X>4 THEN PRINT C$:PRINT:
    PRINT:GOTO 400
430 PRINT CHR$(147):M=1
440 PRINT"GIVE COLUMN TITLE";M;TAB(25);:
    GOSUB 2380
450 PRINT:PRINT:C1$(M)=A$(R,C)
460 T1$=C1$(1)
470 IF M=X THEN 490
480 M=M+1:GOTO 440
490 REM**INPUTTING ENTIRE RECORD
500 PRINT CHR$(147)
510 PRINT"[40 ↑8]"
520 PRINT"[7 SPC]COMMENCE ENTERING
    RECORDS":PRINT
530 PRINT"[7 SPC]PRESS [REV]RETURN[OFF]
    AFTER EACH ENTRY":PRINT
540 PRINT"[40 ↑8]"
550 W$="[REV]WARNING[OFF].DATA
    ACCEPTED.INCONVENIENT.":IR$="ENTER"
560 FOR R=1 TO Y
570 FOR C=1 TO X
580 IF C <> 1 THEN 610
590 PRINT IR$;T1$;TAB(25);:GOSUB 2380
600 PRINT:GOTO 640
610 PRINT:PRINT IR$;C1$(C);TAB(25);:GOSUB
    2380
620 PRINT:IF LEN(A$(R,C))<7 THEN 640
630 PRINT:PRINT W$
640 NEXT
650 PRINT:PRINT"[40 ↑8]"
660 NEXT
```

MULTIPURPOSE RECORDS



An example of an Inventory type file.

```
 670 GOTO 110
 680 REM**SAVE FILE
 690 PRINT CHR$(147):PRINT TAB(240):T=2
 700 PRINT:PRINT"ENTER FILE NAME";TAB(18);:
     GOSUB 2380
 710 PRINT CHR$(147):PRINT TAB(240):PRINT
     "WILL THIS BE LAST FILE ON THIS TAPE?
 720 PRINT"ANSWER Y(YES) OR N(NO)":PRINT
 730 GET K$:IF K$=" " THAN 730
 740 IF K$="N" THEN T=1
 750 PRINT TAB(120)
 760 PRINT"HAVE YOU INSERTED A
     CASSETTE?":PRINT
 770 PRINT"HAVE YOU REWOUND IT TO
     DESIRED POSITION":PRINT
 780 PRINT"HAVE YOU SWITCHED MOTOR
     OFF?":PRINT:PRINT
 790 PRINT"[REV]YOU MUST NOW ANSWER
     Y(YES)"
 800 GET K$:IF K$<>"Y" THEN 800
 810 F$=A$(R,C)
 820 PRINT CHR$(147):PRINT TAB(240)
 830 GOSUB 1650
 840 OPEN 1,1,T,F$
 850 PRINT#1,Y:PRINT#1,X
 860 FOR R=1 TO Y
 870 FOR C=1 TO X
 880 PRINT#1,A$(R,C)
 890 NEXT:NEXT
 900 FOR H=1 TO X
 910 PRINT#1,C1$(H)
 920 NEXT
 930 GOSUB 1670
 940 CLOSE 1
 950 PRINT:PRINT:PRINT"DATA NOW ON TAPE"
 960 GOSUB 2620
 970 GOTO 110
 980 PRINT CHR$(147):PRINT:REM**LOAD TAPE
 990 PRINT"ENTER FILE NAME";TAB(19);:GOSUB
     2380
1000 PRINT:PRINT TAB(240)
1020 PRINT"IS THIS FILE IN CASSETTE?":PRINT
1030 PRINT"IS IT REWOUND?":PRINT
1040 PRINT"IS THE MOTOR SWITCHED OFF?":
     PRINT:PRINT:PRINT
1050 PRINT"IF SO, ANSWER Y(YES)"
1060 GET H$:IF H$=" " THEN 1060
1070 IF H$ <> "Y" THEN 1060
1080 PRINT CHR$(147):PRINT TAB(240)
1090 F$=A$(R,C)
1100 OPEN 1,1,0,F$
1110 INPUT#1,Y$:INPUT#1,X$
1120 GOSUB 1740
1130 Y=VAL(Y$):X=VAL(X$)
1140 FOR R=1 TO Y
1150 FOR C=1 TO X
1160 INPUT#1,A$(R,C)
1170 GOSUB 1740
1180 NEXT:NEXT
1190 FOR H=1 TO X
1200 INPUT#1,C1$(H)
1210 GOSUB 1740
1220 NEXT
1230 CLOSE1:GOSUB 2620
1240 GOTO 110
1250 REM**SORT
1260 PRINT CHR$(147)
1270 PRINT"ENTER COLUMN HEADING";TAB(30);
1280 GOSUB 2380
1290 GOSUB 2620
1300 PRINT CHR$(147):PRINT TAB(250);"SORT
     PROCEEDING"
1310 D$=A$(R,C)
1320 FOR M=1 TO X
1330 IF D$=C1$(M) THEN C=M
1340 NEXT
1350 FOR J=2 TO Y
1360 R=J-1
1370 A$=A$(J,C)
1380 IF A$>=A$(R,C) THEN 1470
1390 A$(R+1,C)=A$(R,C)
1400 FOR L=1 TO X
1410 T$=A$(R,L)
1420 A$(R,L)=A$(R+1,L)
1430 A$(R+1,L)=T$
1440 NEXT L
1450 R=R-1
1460 IF R>0 THEN 1380
1470 A$(R+1,C)=A$
1480 NEXT J
1490 GOTO 110
1500 PRINT CHR$(147)
1510 PRINT"TOTALS":PRINT
1520 GOSUB 2660
1530 PRINT T5(1);TAB(15)T5(2);TAB(23)T5(3)
     TAB(31)T5(4)
1540 PRINT"[40↑8]":PRINT:PRINT:PRINT
1550 PRINT"AVERAGES":PRINT
1560 GOSUB 2660
1570 IF Y=0 THEN Y=1E-30
1580 FOR G=1 TO X
1590 T5(G)=T5(G)/Y:T5(G)=INT(100*T5(G))/100
```

```
1600 NEXT
1610 PRINT T5(1)TAB(15)T5(2)TAB(23)T5(3)TAB
     (31)T5(4)
1620 PRINT"[40 ↑8]"
1630 PRINT:PRINT:PRINT:GOSUB 2620
1640 GOTO 110
1650 REM**PREPARE TO OPEN WRITE
1660 POKE 243,122:POKE 244,2:RETURN
1670 REM**PREPARE TO CLOSE WRITE
1680 IF PEEK(625)>180 THEN 1700
1690 RETURN
1700 POKE 59411,53:T8=TI
1710 IF TI-T8<6 THEN 1710
1720 POKE 59411,61
1730 RETURN
1740 REM**FOLLOW INPUT#1 BREAK
1750 IF (ST)=0 OR (ST)=44 THEN 1770
1760 PRINT" STATUS ERROR"
1770 RETURN
1780 REM**PRINT FILE
1790 GOSUB 2440
1800 PRINT
1810 GOSUB 2620
1820 GOTO 110
1830 REM**SELECT RECORD
1840 GOSUB 1870
1850 GOSUB 2620
1860 GOTO 110
1870 REM**EXAMINE RECORD
1880 PRINT CHR$(147):PRINT:M2=0
1890 IF M2=1 THEN 1980
1900 PRINT:PRINT:PRINT:PRINT" ENTER COLUMN
     HEADING . . . . .";
1910 J=0:Z=0:K=0
1920 GOSUB 2380
1930 F$=A$(R,C):PRINT:M$=F$
1940 FOR M=1 TO X
1950 IF F$=C1$(M) THEN Q=M:J=1
1960 NEXT
1970 IF J=0 THEN PRINT:PRINT" NO SUCH
     COLUMN EXISTS":PRINT:GOTO 1900
1980 PRINT:PRINT" ENTER SEARCH DATA . . . .";
1990 Z=0:K=0
2000 GOSUB 2380
2010 PRINT:D1=0
2020 PRINT CHR$(147):PRINT TAB(120)
2030 GOSUB 2660
2040 R$=A$(R,C)
2050 FOR R=1 TO Y
2060 Z=0
2070 FOR C=1 TO X
2080 IF A$(R,Q)=R$ THEN PRINT A$(R,C);
     TAB(08+8*C):Z=1:R1=R:D1=1
2090 NEXT
2100 IF Z=0 THEN 2120
2110 PRINT
2120 NEXT
2130 PRINT"[40 ↑8]"
2140 PRINT:IF D1=0 THEN PRINT" RECORD NOT
     ON FILE":G=1
2150 RETURN
2160 GOSUB 2620
2170 GOTO 110
2180 REM**MODIF REC
2190 M2=1:Q=1
2200 PRINT CHR$(147)
2210 PRINT" THE TERM SEARCH DATA BELOW
     REFERS TO"
2220 PRINT"[9 SPC][11 ↑8]"
2230 PRINT" WHICH ";C1$(1)
2240 GOSUB 290
2250 PRINT
2260 IF D1<>0 THEN 2290
2270 PRINT:GOSUB 2620
2280 GOTO 110
2290 F$=C1$(1)
2300 PRINT" PROCEED TO MODIFY":PRINT
2310 FOR C=1 TO X
2320 PRINT IR$;" ";C1$(C);". . . . .";TAB(20)
2330 GOSUB 2380
2340 L$=A$(R,C)
2350 A$(R1,C)=L$:PRINT:PRINT
2360 NEXT
2370 GOTO 110
2380 REM**CRASH PROOF INPUT
2390 OPEN 1,0
2400 INPUT#1,A$(R,C)
2410 IF A$(R,C)=" " THEN 2400
2420 CLOSE 1
2430 RETURN
2440 REM**SR TO PRINT FILE
2450 PRINT CHR$(147)
2460 GOSUB 2660
2470 S=1:V=1:T5(1)=0:T5(2)=0:T5(3)=0:
     T5(4)=0
2480 FOR R=1 TO Y
2490 FOR C=1 TO X
2500 T5(C)=T5(C)+VAL(A$(R,C))
2510 IF C>1 THEN 2540
2520 PRINT A$(R,C);
2530 GOTO 2550
2540 PRINT TAB(08-8*C)A$R,C);
2550 NEXT
2560 PRINT
2570 IF S=18 THEN GOSUB 2620
2580 IF S=18 THEN S=1
2590 S=S+1
2600 NEXT
2610 RETURN
2620 REM**PRESS K
2630 PRINT:PRINT" PRESS ANY KEY"
2640 GET K$:IF K$=" " THEN 2640
2650 RETURN
2660 REM**PRINT TABLE HEADINGS
2670 PRINT"[40 ↑8]"
2680 PRINT C1$(1);TAB(16)C1$(2);TAB(24)
     C1$(3)TAB(32)C1$(4)
2690 PRINT"[40 ↑8]"
2700 RETURN
```

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BASIC LIFE

Paul Evans

Playing the game of Life is an addictive occupation and it is one of the most popular games programs. This version is unusual in that it is written in UK101 BASIC and only uses 4K of memory. The rules of the game are as follows;

1) each cell can hold one organism and is deemed to be 'adjacent' to eight other cells around it,
2) if the organism is adjacent to less than two others it will die of loneliness,
3) if the organism is adjacent to more than three others it dies of overcrowding,
4) if an unoccupied cell is adjacent to exactly three organisms a new organism is formed in that cell,
5) all 'births' and 'deaths' occur simultaneously.

Another rule usually considered is that the game is played on an infinite plane divided into cells but in this version the size of the screen and the time taken to perform each move have limited the space available.

Running The Program

After RUN is typed the playing area is outlined by a rectangle and commands for cursor control, producing and deleting cells and starting and stopping growth are given. Using these commands a colony of organisms is set up and the game can start.

At any time during the game the growth can be terminated by pressing '8' which induces stagnation. Natural stagnation will occur when, at the end of a scan, no cells have either been 'born' or have 'died'. As a result of this the screen is cleared but the generation count is still maintained as a score.

Observations

The routine in lines 170-290 which forms the rectangle uses the following data format, NC,SL,TY,NL,O where NC is the number of characters per line, SL is the start location of the characters, TY is the character type and NL is the number of lines.

Cursor control is handled in lines 310-470 and uses a monitor subroutine to input characters from the keyboard. Line 430 stops the cursor from moving outside the playing area.

The main difference between this and other games of Life is the "Cell Scan" routine which is located from 530-650. Instead of housing the colony status in an array or matrix this program uses the character slots in the video RAM as the cells, the graphics character 226 being an organism and a blank space being an empty cell. This saves time on transmitting matrix information to the screen and also uses less RAM.

The actual scan process involves PEEKing the character slots adjacent and adding one to the FC count for each organism found. Replacing lines 560-630 with a subroutine would slow the scan rate by about 25 seconds so the method given has to be used.

The section of the program that looks after the 'birth' and 'death' of cells is located from 650-690. The arrays B and D limit the number of cells that can be generated or destroyed in each cycle. DIMensioning them both for 70 elements is large enough for most colonies and will still fit within a 4K machine.

All the rest of the code is fairly straightforward, hence the lack of flowcharts. Replacing lines 540-890 with a machine code routine would speed the game up considerably and should not be too hard to attempt as all locations are absolute.

```
 10 REM***LIFE BY EVANS***
 20 DIM D(70),B(70)
 30 REM**DISPLAY**
 40 PRINT:PRINT:PRINT TAB(26);"generation"
 50 PRINT:PRINT:PRINT" control"
 60 PRINT" - - - - - - - - - -"
 70 PRINT" 1= ";CHR$(94)
 80 PRINT" 2= ";CHR$(20)
 90 PRINT" 3= ";CHR$(22)
100 PRINT" 4= ";CHR$(18)
110 PRINT" 5= cell"
120 PRINT" 6= delete"
130 PRINT" 7= start"
140 PRINT" 8= stop"
150 PRINT
160 REM**RECTANGLE**
170 DATA 35,53399,128,1
180 DATA 1,53462,153,12
190 DATA 1,53498,152,12
200 DATA 35,54231,135,1,0
210 READ NC:IF NC=0 GOTO 310
220 READ SL,TY,NL
230 FOR X1=1 TO NL
240 FOR X2=0 TO NC-1
250 POKE SL+X2,TY
260 NEXT X2
270 SL=SL+64
280 NEXT X1
290 GOTO 210
300 REM**CURSOR/CONTROL**
310 CUR=54167:CS=32
320 POKE CUR,161
330 POKE 11,0:POKE 12,253:O=USR(O)
340 A=VAL(CHR$(PEEK(531)))
350 IF A=5 THEN CS=266:GOTO 330
360 IF A=6 THEN CS=32:GOTO 330
370 IF A=7 THEN POKE CUR,CS:GOTO 490
380 IF A=1 THEN EX=-64
390 IF A=2 THEN EX=64
400 IF A=3 THEN EX=-1
410 IF A=4 THEN XE=1
420 V=PEEK(CUR+EX)
430 IF V<>32 AND V<>226 GOTO 330
440 POKE CUR,CS
450 CUR=CUR+EX
460 CS=PEEK(CUR)
470 GOTO 320
480 REM**GENERATION COUNTER**
490 G$=SRT$(G):L=LEN(G$)
500 FOR X3=1 TO L
510 POKE 53364-X3,ASC(MID$(G$,L-X3+1,1))
```

```
520 NEXT X3
530 REM**CELL SCAN**
540 S=53463:BP=1:DP=1
550 FC=0
560 IF PEEK(S-65)=226 THEN FC=FC+1
570 IF PEEK(S-64)=226 THEN FC=FC+1
580 IF PEEK(S-63)=226 THEN FC=FC+1
590 IF PEEK(S-1)=226 THEN FC=FC+1
600 IF PEEK(S+1)=226 THEN FC=FC+1
610 IF PEEK(S+63)=226 THEN FC=FC+1
620 IF PEEK(S+64)=226 THEN FC=FC+1
630 IF PEEK(S+65)=226 THEN FC=FC+1
640 REM**DECIDE BIRTH/DEATH**
650 IF PEEK(S)=226 GOTO 680
660 IF FC<>3 GOTO 710
670 B(BP)=S:BP=BP+1:GOTO 710
680 IF FC>AND FC<4 GOTO 710
690 D(DP)=S:DP=DP+1
700 REM**INCREMENT TO NEXT CELL**
710 S=S+1
720 IF PEEK(S)=152 THEN S=S+29
730 REM**TEST FOR KEY'8'**
740 POKE 530,1:POKE 57088,191
750 K=PEEK(57088):POKE 530,0
760 IF K=127 GOTO 910
770 IF S<>54231 GOTO 550
780 IF DP=1 AND BP=1 GOTO 910
790 REM**IMPLEMENT DEATHS**
800 FOR X4=1 TO DP-1
810 POKE D(X4),32
820 NEXT X4
830 REM**IMPLEMENT BIRTHS**
840 IF BP=1 GOTO 890
850 FOR X5=1 TO BP-1
860 POKE B(X5),226
870 NEXT X5
880 REM**NEXT GENERATION**
890 G=G+1:GOTO 490
900 REM**STAGNATION ROUTINE**
910 FOR X6=0 TO 9
920 POKE 53335+X6,ASC(MID$
    ("STAGNATION",X6+1,1))
930 NEXT X6
940 REM**CLEAR RECTANGLE**
950 P0=53463
960 FOR X7=0 TO 34:POKE P0+X7,32:NEXT
    X7
970 P0=P0+64
980 IF P0<>54231 GOTO 960
990 FOR X8=53335 TO 53345:POKE X7,32:
    NEXT X7
1000 G=0:GOTO 310
```

The complete game of LIFE in BASIC for a UK101.

ACORN CLOCK

Simon Letts

Having seen the Kim Clock that was published in the February issue of CT and being in possession of another 6502 based system, namely the Acorn, I decided to make the necessary alterations. The following listing is the result of that effort. The program starts by clearing the display and loading the value 00 into the seconds counter. The monitor subroutine at FE88 is used to directly input the hours, minutes.

The main program is identical to the original except that it stores hours, minutes and seconds in 007C. 7B and 7A respectively. An extra subroutine has been added to the display segment which uses monitor routines to display hours and minutes as well as seconds. This addition means that the original timing adjustment was not accurate enough and an extra delay loop was added with coarse adjustment at 006D and fine adjustment at 0072. These values should be altered until the clock is sufficiently accurate for your needs.

```
0020  A9  00
0022  85  10        ;Set up clock
0024  85  7A
0026  A2  7B
0028  20  88  FE    ;Use monitor routine
002B  A9  1F        ;To load hrs, mins
002D  85  0E
002F  20  62  00    ;Start of main program
0032  A2  00
0034  E0  02
0036  D0  11
0038  A9  23
003A  D5  7A
003C  D0  19
003E  A9  00
0040  85  7A
0042  85  7B
0044  85  7C
0046  4C  2F  00
0049  A9  59
004B  D5  7A
004D  D0  08
004F  A9  00
0051  95  7A
0053  E8
0054  4C  34  00
0057  18
0058  F8
0059  B5  7A
005B  69  01
005D  95  7A
005F  4C  2F  00
0062  A2  7B        ;Start of display
0064  20  64  FE
0067  A5  7A
0069  20  60  FE
006C  A2  2C        ;Course timing constant
006E  20  0C  FE
0071  A0  0A        ;Fine timing constant
0073  88
0074  D0  FD
0076  CA
0077  D0  F5
0079  60
```

Hex code for the Acorn clock. Main body of program is relocated from KIM clock program.

Owen Bishop

Digital information may sound good to a micro but it'll sound better to you when you feed it through this month's Microlink.

In this month's offering we describe an interface that will enable you to do several interesting and useful things with your micro, including playing tunes! The interface comprises two independent sections: a digital to analogue converter and an audio amplifier; the two may be easily combined.

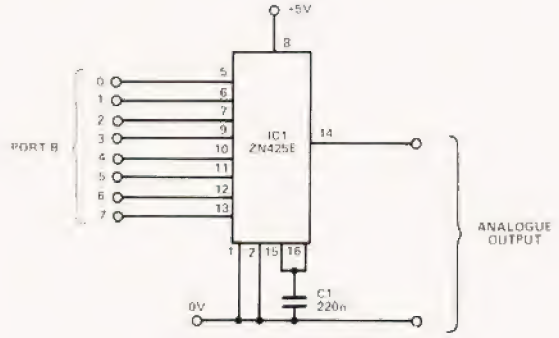

Fig 1. The D to A circuit diagram

The Conversion System

This circuit consists of a single IC, see Fig.1, that accepts an eight bit input from the microprocessor system and produces an output voltage that is directly proportional to the binary value of that input byte. The layout of the circuit board is given in Fig.2. As can be seen there are three PCB plugs of the same type as used in the Thermoface unit, see July's CT, so you can re-use these if you wish. Remember to plug them the right way round though, as they carry power supply voltages.

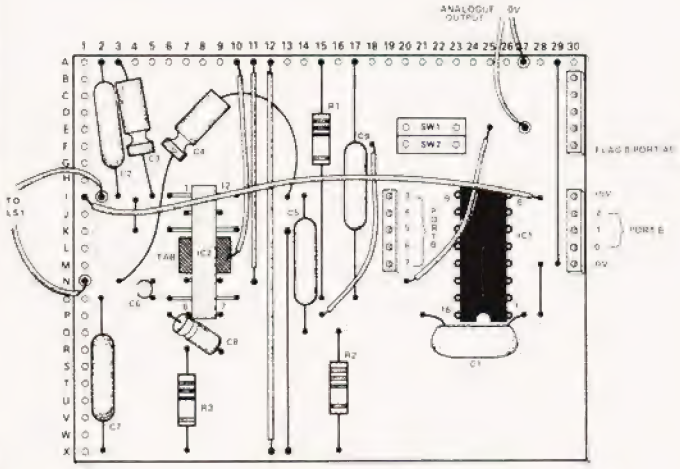

Fig 2. The breadboard layout for both circuits

There are also two terminal pins on the board, 0 V and the IC output, You can connect a multimeter across these to monitor the IC during tests. Programs A and B both activate the eight outputs at Port B and by varying the byte value you can obtain different values on the meter. The specified output is 8.5 mV per unit input. Thus for an input of 255 (all high) we should obtain 2V17 (255*0.0085). In a later section of this series we will show you how to use this voltage to control things but for now we present...

The Power Section

The audio amplifier, see Fig.3, is based on a common audio IC which can be run from the supplies available. There are two large tabs on the chip, they should be connected to earth as shown or you won't get it to work!

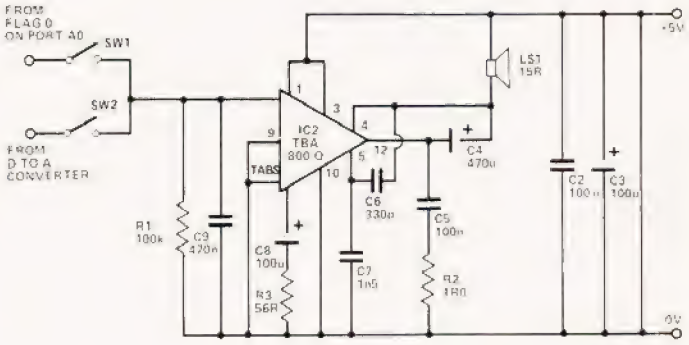

Fig 3. The amplifier section circuit

PARTS LIST

Resistors, all ¼ W	
R1	100k
R2	1R0
R3	56R
Capacitors	
C1	220n Polyester
C2,5	100n Polyester
C3,8	100u 16V electrolytic
C4	470u 16V electrolytic
C6	330p Polystyrene
C7	1500p Polystyrene
C9	470n Polyester
Semiconductors	
IC1	ZN425E
IC2	TBA800Q

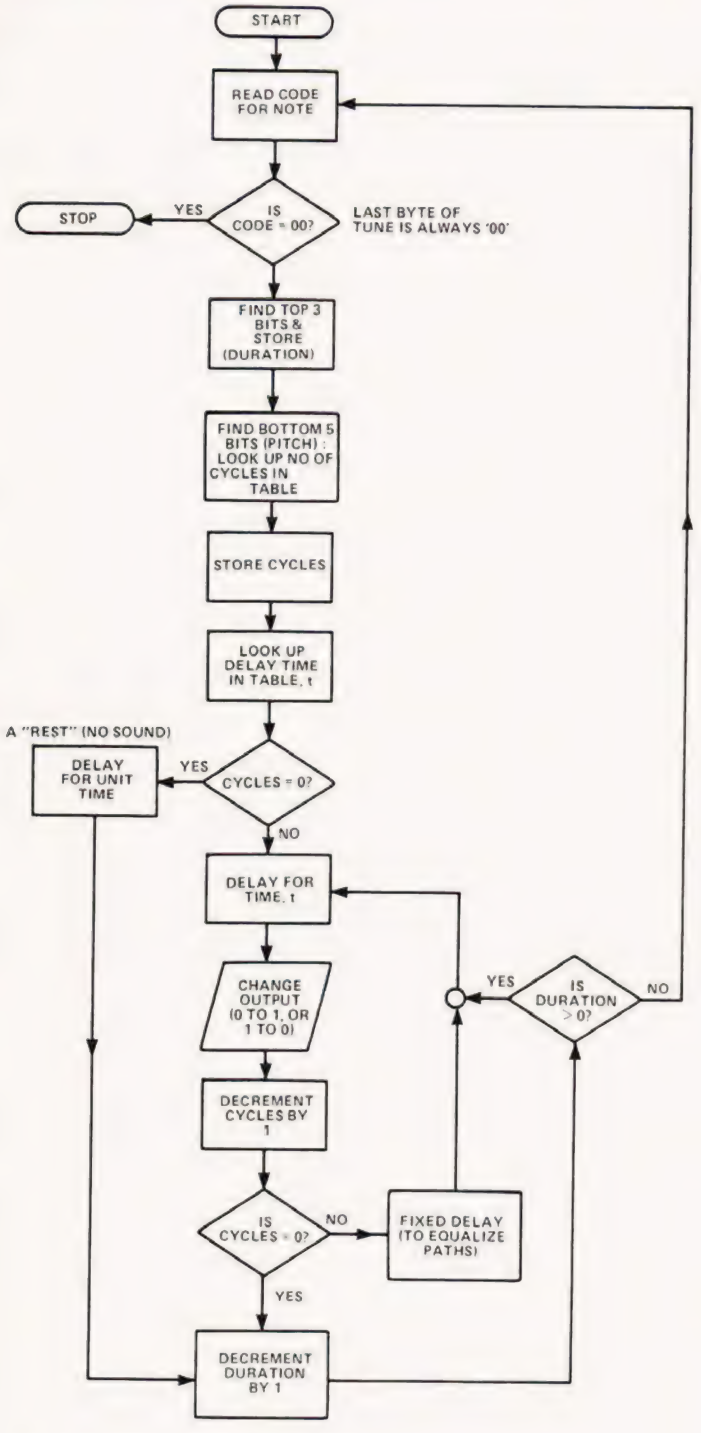

Fig 4. Flowchart for the music program

The DIL switches are supplied to connect the amplifier directly to the converter or to a Flag output of the Mk 14. The handbook gives a "Music Box" program that runs through any Flag output. Owners of other systems may like to try programming their system to play tunes by following the scheme shown in Fig.4 The tune is stored in memory as a series of single bytes, each one representing a note. The top three bits represent the duration and the bottom five give its pitch. To produce the required note the flag output of the system is turned on and off at the appropriate frequency. The program needs a table to determine the delay needed to produce the required frequency. It also needs a second table to give the number of oscillations at that frequency to produce a note of "standard" length. This length is doubled or otherwise increased depending on the value found in the first three bits of the note code.

Once the program has been loaded it is fairly easy to transcribe a tune from a musical score to obtain the code sequence.

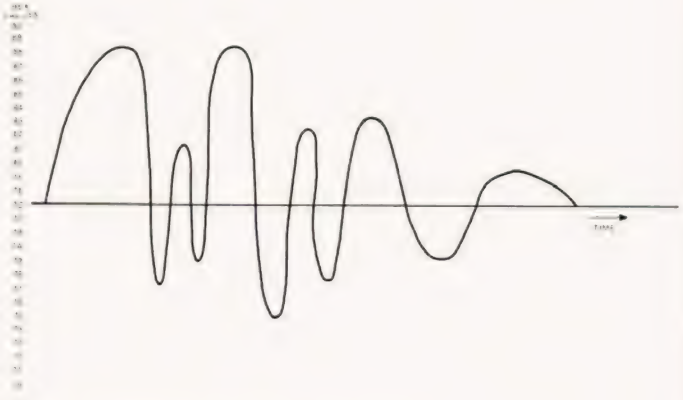

Fig 5. A "scribbled" waveform, see Table 4.

Generating Functions

Yet another use for the hardware is the "Function Generator" program from the Mk 14 manual, a version for Acorn is given in Program C. This uses the D to A converter connected to the audio amplifier. By sending a string of bytes a complex waveform may be produced, the pitch is set by the speed of the program but the sound quality can be changed by altering the byte values.

To calculate a series of values is not difficult. A few minutes with a set of tables, or calculator, will enable you to produce a sine wave. By using the formula $y = \sin(x)$ and taking say forty points we can arrive at a set of numbers. These have to be scaled so they are centered about 125, it is quite suitable to multiply each value by 20 and add 125. A typical set of results is given in Table 1.

More complex waveforms have more complex equations. Table 2 is the result of calculating $y = \sin(x) + \sin(2x) + \sin(3x) + \sin(4x) + \sin(5x) + \sin(6x)$. This gives a waveform that is the sum of the fundamental plus the first five harmonics, all having equal amplitude. This sounds different to the result of Table 1, and is also different to the waveform produced by Table 3. The values in Table 3 are the odd harmonics only.

A quick and easy way to make your own waveforms is to draw it on graph paper and simply read off the values. Fig.5 and Table 4 are a typical example.

Once the program has been loaded it is fairly easy to transcribe a tune from a musical score to obtain the code sequence.

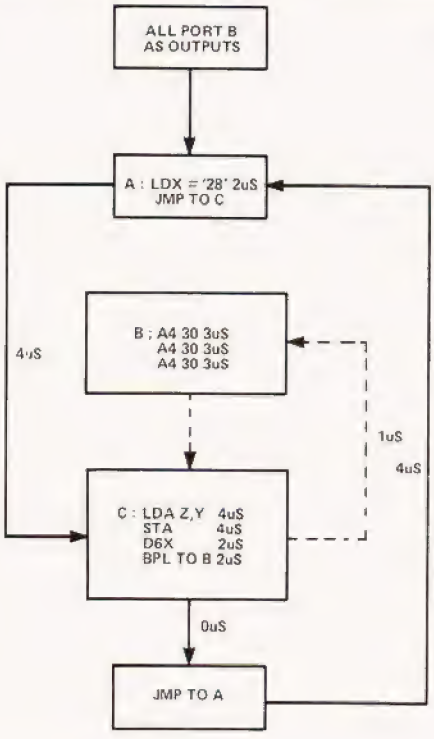

Fig 6. The loop equalisation section of Program C

```
0030  A9  FF        LDA   #FF   Define Port B as output
0032  8D  23  08    STA   0DB
0035  A9  80        LDA   #80   Value to go to A to D
0037  8D  21  09    STA         Output to Port B
003A  4C  04  FF    JMP         Jump back to monitor
```

Program A. The test program for the D to A converter which can be used as a subroutine. In 6502 code for Acorn, relocatable.

```
0F20  C4  0A        LDI   0A    Set P1 to I O device
0F22  35            XPAH  P1
0F23  C4  00        LDI   00
0F25  C4  FF        LDI   FF    Define Port B as OUTPUT
0F28  C8  23        ST    P1 + 23
0F2A  C4  80        LDI   80    Value to go to A to D
0F2C  C8  21        ST    P1 + 21  Value output from Port B
0F2E  3F            XPPC  P3    Return to monitor
```

Program B. As program A but for the Mk 14.

```
0030  A9  FF        LDA   #FF   Define Port B as OUTPUT
0032  8D  23  08    STA   0DB
0035  A2  27      A LDX   #28   Number of points in Hex
0037  4C  3E  00    JMP   C     See Fig 6
003A  A4  30      B LDY   Z,30  3uS delay
003C  A4  30        LDY   Z,30  3uS delay
003E  A4  30        LDY   Z,30  3uS delay
0040  B5  60      C LDA   Z,X   Address of first point
0042  8D  21  09    STA         Value of point output at
                                Port B
0045  CA            DEX         Ready for next point
0046  10  F2        BPL   B     If there is another
0048  4C  35  00    JMP   A     Repeat
0060 to 0087                    Waveform values
```

Program C. Function generator program for Acorn.

7D	80	83	86	89	8B	8D	8F
90	91	91	91	90	8F	8D	8B
89	86	83	80	7D	7A	77	74
71	6F	6D	6B	6A	69	69	69
6A	6B	6D	6F	71	74	77	7A

Table 1. A sine wave, y = sin(x) 20 + 125 converted to Hex.

7D	B9	D9	D1	AF	8B	7C	81
90	9C	91	82	79	7A	84	8B
88	7F	76	75	7D	85	84	7B
71	6F	76	80	81	78	69	62
6A	79	7F	6F	4B	29	21	41

Table 2. A sine wave with all the harmonics

7D	A9	B8	A5	89	7D	86	91
90	84	7D	84	90	91	86	7D
89	A5	B8	A9	7D	51	42	55
71	7D	74	69	6A	76	7D	76
6A	69	74	7D	71	55	42	51

Table 3. Another sine wave but with only the odd harmonics

7D	81	84	86	87	88	88	87
78	78	81	79	81	88	89	88
77	75	7D	82	82	77	7D	82
83	84	83	7F	7B	79	79	79
7B	7E	7F	80	7F	7E	7E	7D

Table 4. The values taken from the "scribbled" waveform of Fig.5.

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Computerise your day-to-day happenings with this versatile piece of BASIC software.

Here is yet another morsel of food to keep your 'Housetrained PET' from starving. Doubtless there are many readers who will attempt a diary program for themselves as one of their first tasks. We would not dare boast that this is the best, but hope that everyone will find it some use, either in whole or in part.

The listing is in PET BASIC. The only criterion for transferring to other dialects is the need for good string handling facilities, you don't even need floating point arithmetic.

Fresh Dates

The screen will display nine catagories of events or engagements and will be prompting for your choice. The category names are stored as DATA stagements in lines 60050-60070. These can be set-up to the individuals requirements with the following limitations:-

a) Holidays must be stored as the first statement. The reason for this is that there is a holiday block routine that has been written using the first position. Details of this are given later.

b) As the program stores the event number and not the event name when producing a data tape, events cannot be moved from one position to another *unless* there are no entries existing under the new position.

Once you have decided on your entry, the program will ask for a date. A check is then made to see if there are any other entries on that date. If an entry exists, it is listed and a chance is given to abort from the operation. If you carry on, or there is no other entry, the program will then ask for a message. Don't bother inserting the event name, for, as mentioned earlier, the program will have already sorted the event number and will convert that back to the text when displaying on the screen. The event number is stored as the first position in the message text. For this reason, it is not possible to put figures at the beginning of your message. If the time of (say) a dentist visit is required then put it as follows:-

Check-up 3.30 *not* 3.30 Check-up

Once your message has been entered two further checks are made to ensure there is enough memory and there is a string available in memory. A conversion is then made of your date. This is on a day numbering basis where 1st January 1980 = 1. This routine does not take into account 29th February, in fact it assumes that every year is a leap year. It would be fairly easy to rewrite this part to take leap years into account, but the extra memory used in comparison to the facilities achieved did not make it seem worthwile.

After your message has been placed in memory, a message is displayed as to the amount of memory and entry positions left available. The two figures are not inter-related. It is quite possible to have room for 150 entries with only 60 bytes free. While this message is being displayed a bubble sort routine is entered to put all entries into a chronological order. The reason this is done is to give any listings an orderly fashion when displayed on the screen.

Cancelling A Date

There is nothing special about this routine. It asks for the date you are interested in and then lists all events stored under that date. An option is given to the user to delete or save. This is repeated until all entries under that particular date have been exhausted.

Forward Planning

This facility gives a printout of all events for the next seven days. If the user wishes to alter this to (say) fourteen days then it would be a simple matter to alter the program as follows:-

```
3000.....D%(J)>D2+15 THEN 3100
```

Holidays

A very time consuming part of any diary upkeep is the entry of holidays. Instead of having to input the holiday day by day, this program will take them "en bloc". A start date and finish date are requested. The program goes through the usual routines to check for double entries and sufficient space. If other entries are found that the user wishes to delete, it is quicker to leave them until the holidays have been entered, and then go back to the delete routine.

Listing Events

How many times have you wondered "when is so-and-so's wedding anniversary". If this is your problem, then select this routine and hit the event number corresponding to ANNIVERSARY, the program will then give you a full list of anniversaries (or whatever event you are interested in). If you require a list of all events under a specific date then use the cancellation routine to give you the list.

Data Tapes

The data tape production routine has a motor switching operation incorporated into it. As there is no need to keep the previously saved data, the tape should be rewound to its start position prior to any tape update.

Running The Program

The usual password has been incorporated to help with privacy. Once this has been cleared the program will want to know whether there is data already existing on tape. If data is on tape the program will prompt the user to enter the tape. After the data has been read in a message will be displayed as to when the tape was last accessed. The program will then continue to ascertain today's date. The program will then give a list of all events that have occured since the last tape dump. You are given a choice to delete or put back into memory for next year (by adding 366 to the day index figure).

The Listing
The listing, as mentioned earlier, is in PET BASIC. Here is the shorthand used:-

[CLR]	Clear screen routine
[PASSWORD]	Your particular password
[CD]	Cursor down
[CU]	Cursor up
[CL]	Cursor left
[CR]	Cursor right
[REV]	Reverse video on
[REV OFF]	Reverse video off

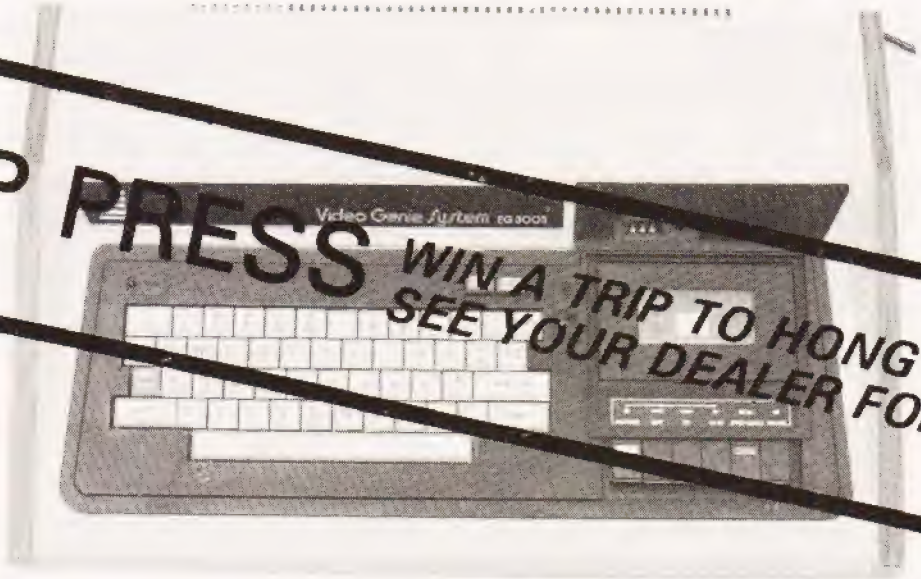
Screen Display
As most people will have their own ideas on how the information should be displayed, not much thought has been given to the format in this program. If you alter the program to allow a fourteen day forward plan then some sort of routine will have to be incorporated to interrupt the scrolling action of the screen. There are two popular methods:-
1. Scan the keyboard and, if a key has been pressed, stop printing until another key is touched
2. Count the number of lines and (say) stop printing at 20 lines and use the subroutine at line 750 as a waiting loop.

```
 10 DIM D%(255),D$(255),M$(12)
 20 N$="DIARY DATA": POKE59468,14:
    Z=32500: W=255: X=366
 30 FOR J=0 TO W: D%(J)=Z: NEXT
 40 INPUT"[CLR]PASSWORD";A$: IF A$<>
    "[PASSWORD]" THEN NEW
 50 INPUT "[CLR]Is this a first run";A$
 60 IF LEFT$(A$,1)="Y" THEN 140
 70 PRINT "[2 CD][REV]PLEASE INSERT "N$"
    TAPE AND": PRINT "[CD][REV]FULLY
    REWIND": GOSUB 750
 80 OPEN 1,1,0,N$: PRINT N$ "FILE FOUND
 90 FOR I=0 TO W: INPUT#1,A: IF A=-99
    THEN 120
100 D%(I)=A: INPUT#1,D$(I): NEXT
120 INPUT#1,D2: CLOSE 1
140 FOR J=1 TO 12: READ M: NEXT
150 FOR J=1 TO 12: READ M$(J): NEXT
160 FOR J=1 TO 9: READ E$(J): NEXT:
    RESTORE
170 A=D2: PRINT "[CD]File last accessed on
    [CD]": GOSUB 8400
180 GOSUB 8000: D2=A: C=0
190 PRINT "[2 CD]I am looking for obsolete
    entries
200 FOR J=0 TO W: IF D%(J)>D2 THEN 250
210 A=D%(J): GOSUB 8400: GOSUB 8310
220 PRINT "[2 CD]Do you want this kept for
    next year?
230 GOSUB 800: IF R$="Y" THEN D%(J)=
    D%(J)+X: NEXT: GOTO 250
240 C=1: D%(J)=Z: D$(J)=" ": NEXT
250 IF C=1 THEN GOSUB 8200
260 PRINT "[CLR]"TAB(13)"PERSONAL DIARY
270 PRINT "TAB(19)"[CD]by
280 PRINT "TAB(10)"[CD]Elaine Douse
290 PRINT "TAB(10)"[3 CD]1. ADD NEW
    ENTRIES
300 PRINT "TAB(10)"[CD]2. DELETE ENTRIES
310 PRINT "TAB(10)"[CD]3. 7 DAY FORWARD
    PLAN
320 PRINT "TAB(10)"[CD]4. ADD HOLIDAY
    BLOCKS
330 PRINT "TAB(10)"[CD]5. LIST (by event)
350 PRINT "TAB(10)"[CD]6. PRODUCE DATA
    TAPE
360 GOSUB 8600
380 IF C>6 OR C<1 OR C<>INT(C) THEN
    260
400 ON C GOTO 1000,2000,3000,4000,
    5000,7000
750 PRINT "[CD][REV]PRESS ANY KEY TO
    CONTINUE": GOTO 810
800 PRINT "[CD][REV]PRESS 'Y' OR 'N'
801 GOSUB 810: IF R$<>"Y" AND R$<>
    "N" THEN 801
802 RETURN
810 GET R$: IF R$=" " THEN 810
820 RETURN
1000 FOR I=0 TO W: IF D%(I)=Z THEN 1040
1030 NEXT: GOTO 8710
1040 PRINT "[CLR]";: GOSUB 8100: GOSUB
     8000
1070 FOR J=0 TO W: IF D%(J)<A THEN NEXT
1080 IF D%(J)>A THEN 1500
1090 GOSUB 8300
1130 PRINT "[2 CD]Do you wish to carry on?
1140 GOSUB 800: IF R$="N" THEN 260
1150 NEXT
1500 D$(I)=STR$(C): D$(I)=RIGHT$(D$(I),1):
     D%(I)=A
1520 GOSUB 8700: D$(I)=D$(I)+A$
1530 PRINT "[2 CD][REV]NOTE[OFF]You have
     "FRE(0)" BYTES FREE
1540 PRINT "and room for" W-(I)" entries":
     PRINT" Any more ?
1560 GOSUB 800: IF R$="Y" THEN 1000
1570 GOSUB 8200: GOTO 260
2000 PRINT "[CLR]": C=0: GOSUB 3000
2020 FOR I=0 TO W: IF D%(I)<> A THEN
     NEXT: GOTO 2070
2030 J=I: GOSUB 8300: C=1
2040 PRINT "[CD]Do you want this kept ?
2050 GOSUB 800: IF R$="Y" THEN NEXT:
     GOTO 2070
2055 FOR J=I TO W-1: D%(J)=D%(J+1):
     D$(J)=D$(J+1): NEXT
2060 D%(W)=Z: D$(W)=" ": NEXT
2070 IF C=1 THEN 2100
2080 PRINT "Sorry no entries found for that
     date": GOTO 2110
2100 PRINT "Sorry no more entries found
2110 PRINT "Have you any more deletions
2120 GOSUB 800: IF R$="N" THEN 260
2130 GOTO 2000
```

```
3000 PRINT "[CLR]": FOR J=0 TO W: IF
     D%(J)>D2 AND D%(J)<D2+8 THEN 3100
3010 NEXT: GOSUB 750: GOTO 260
3100 A=D%(J): GOSUB 8400: GOSUB 310:
     NEXT
4000 PRINT "[CLR]This is for block
     holidays":PRINT [2 CD][REV]START
     DATE": GOSUB 8000
4020 S=A:PRINT "[2 CD][REV]FINISH DATE":
     GOSUB 8000: F=A
4040 FOR I=0 TO W: IF D%(I)>=S AND
     D%(I)=<F THEN A=D%(I): GOSUB 8400:
     J=I:GOSUB 8300
4060 IF D%(I)=Z THEN 4080
4070 NEXT: GOTO 8710
4080 IF W-I<F-S THEN 8710
4083 GOSUB 8700: A$="1"+A$
4085 FOR J=S TO F: GOSUB 8705: D%(I)=J:
     D$(I)=A$: I=I+1: NEXT: GOSUB 8200:
     GOTO 260
5000 PRINT "[CLR]";: GOSUB 8100:PRINT: FOR
     J=0 TO W: IF VAL(D$(J))=C THEN 5100
5050 NEXT: PRINT "[CD]Search is complete":
     GOSUB 750: GOTO 260
5100 A=D%(J): GOSUB 8400: GOSUB 8320:
     GOTO 5050
7000 PRINT "[CLR]FULLY REWIND DATA
     TAPE": GOSUB 750: POKE 244,2: POKE
     243,122:A=1
7040 OPEN 1,1,A,N$: FOR I=0 TO W: IF D%(I)
     =ZT THEN 7100
7070 PRINT#1,D%(I): GOSUB 7500: PRINT#1,
     D$(I): GOSUB 7500
7100 NEXT
7110 PRINT#1,-99: GOSUB 7500: PRINT#1,
     D2: CLOSE1
7125 A=A+1; IF A=2 THEN 7040
7130 PRINT "FINISHED":END
7500 POKE 59411,53:RETURN
8000 A=0:PRINT"[2 CD]Please enter day,
     month, year (in figures)
8010 INPUT D,M,Y: IF Y<100 THEN
     Y=Y+1900
8030 FOR K=1 TO 12: IF K=M THEN 8050
8040 READ B: A=A+B:NEXT
8050 RESTORE: A=A+D((Y-1980)*X):
     RETURN
8100 FOR K=1 TO 9: PRINT TAB(12)K;E$(K):
     NEXT: GOTO 8600
8200 PRINT "[CD]I AM SORTING
8205 FOR J=0 TO I:K=J+1:FOR L=I TO K
     STEP-1
8210 IF D%(L)>=D%(J) THEN 8230
8220 A=D%(L):A$=D$(L):D%(L)=D%(J):
     D$(L)=D$(J):D%(J)=A:D$(J)=A$
8230 NEXT:NEXT:RETURN
8300 PRINT "[CD]I have found the following for
     that date
8310 PRINT "[CD]"E$(VAL(D$(J)))
8320 PRINT RIGHT$(D$(J),LEN(D$(J))-1):
     RETURN
8400 Y=0
8410 IF A<367 THEN M=1: GOTO 8430
8420 A=A-366: Y=Y+1:GOTO 8410
8430 READ B: IF A>B THEN A=A-B:
     M=M+1: GOTO 8430
8440 RESTORE: D=A: GOSUB 8500: RETURN
8500 PRINT D;M$(M);Y:RETURN
8600 INPUT "[2 CD]Which category do you
     require";C:RETURN
8700 INPUT "[CD]The message please";A$
8705 IF FRE(0)>LEN(A$)+30 THEN RETURN
8710 PRINT "[2 CD]SORRY NO ROOM
     LEFT":GOSUB 8800: GOTO 260
8800 FOR I=1 TO 2500:NEXT:RETURN
60000 REM DAYS IN THE MONTH
60010 DATA 31,29,31,30,31,30,31,31,30,31,
     30,31
60020 REM MONTH NAMES
60030 DATA JANUARY,FEBRUARY,MARCH,
     APRIL,MAY,JUNE,JULY,AUGUST,
     SEPTEMBER
60040 DATA OCTOBER,NOVEMBER,DECEMBER
60050 REM EVENT NAMES
60060 DATA HOLIDAY,USER1,USER2,USER3,
     USER4,USER5,USER6,USER7,USER8
```

BASIC listing for the program, see text for BASIC alterations.

enter the computer age



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TRADE ENQUIRIES WELCOME

M.J. Bell

In the final episode we bring you the program that the whole series has been working towards.

And so to the last part of the series. The ground that has been covered over the past four months has been the preparation for understanding the specimen program listed here. However, a few sentences are still required to complete the picture, and one topic that should be given space is that of Structured Programming.

The Concept

If writing a program can be likened to an author writing a book then structured programming can be likened to the grammar of that prose. The better the grammar, the better the book to read. With programming, the tidier a program looks, and the tighter its construction, the better structured it becomes.

In many ways, I believe, the structuring of programs is very much over-emphasised. It is far more important to the owner of a computer that a program functions correctly rather than whether it looks acceptable to an professional.

The Listing

To describe a listing it is necessary for the first time to specify the CPU and the System Monitor that is being used, as the final listing must obviously vary from CPU to CPU.

The listing shown is for a Zilog Z80 CPU controlled by the NASCOM T2 or T4 monitor. Those with other systems that use various other types of CPU's should not now 'switch off' but accept the challenge to see how it's been done and then write their own listing. A detailed explanation of each instruction has been given and the reader is advised to carefully work through the program line by line analysing each event. If a NASCOM 1 is available then the program can be entered and run, or single stepped through as required.

Debugging

One lesson the programmer quickly learns is that his creations will seldom work first time. The process of investigation and correction is know as 'DEBUGGING', and can often take many hours to complete. If, as with the 'Gregorian Calendar', the result is dependent solely on the input (of which there are x^n possibilities) then sooner or later someone will feed in an input not otherwise considered and a new 'bug' will emerge to the great satisfaction of the operator and the indignation of the writer. The 'debugging' will then begin again.

Use of the monitor 'Breakpoint' command is essential and this, together with the 'single stepping' feature, provides the most valuable tools at your disposal.

Documentation

With the program written, entered, debugged and supposedly finished, the temptation is to file it on magnetic tape and move on to pastures new. To document might seem pointless, not to say time consuming, but it is fatal to omit this stage as sometime in the future a procedure or subroutine worked out for a particular program may be just the thing for a new application, and it is surprising how quickly one forgets how a program works.

Epilogue

Now that this series is complete I hope that it has given many more computer owners the urge to experiment in machine code programming. My only hope is that your efforts will be made available to other enthusiasts as there is much that we can teach each other, and if you feel that you have developed a program that may be of interest to others then send it to us for consideration in the 'SOFTSPOT' column.

```
INITIALISE
0D00  EF 1E 00          RST 28H         Clear Screen
0D03  21 D9 0B          LD HL,0BD9      Set cursor location
0D06  22 18 0C          LD (0C18),HL    to 0BD9
0D06  CD B4 0E          CALL "TITLE"    Print title
0D0C  3E 01     INIT 1  LD A,01         Set the 1st March
0D0E  32 0F 0E          LD (0E0F),A     1756 day shift reference

INPUT
0D11  CD CA 0E          CALL "INST"     Print Instructions
0D14  CD 3E 00    I/P   CALL "CHIN"     Monitor INPUT routine.
0D17  FE 20             CP "SPACE"
0D19  20 05             JRNZ N/L        Jump if not space
0D1B  2A 18 0C    SPACE HL,(0C18)       Put cursor location in HL
0D1E  23                INC HL          Save start of Year CRT
0D1F  E5                PUSH HL         address location
0D20  FE 1F       N/L   CP "NEW LINE"   Is entry complete
0D22  28 05             JRZ "CUR"       Jump if Yes
0D24  CD 3B 01          CALL "CRT"      Monitor output routine
0D27  18 EB             JR INPUT        Do for next character
0D29  2A 18 0C    CUR   HL,(0C18)       Erase cursor from
0D2C  36 20             (HL),20 Hex     CRT display

COPY
0D2E  01 13 00          BC = 13         No. of chars to be copied
0D31  11 D9 0B          DE = 0BD9       Destination Address
0D34  21 A3 0B          HL = 0BA3       Start address
0D37  ED B0             LDIR            Copy Month and Year to top
                                        CRT line

DECIMAL HEX
0D3A  21 00 00          HL = 0          Set counter to 0
0D3D  01 E8 03          BC = 03E8       Set BC = "1,000 Decimal"
0D40  CD 11 0E          CALL "SUM 1"    Add up Milleniums
0D43  01 64 00          BC = 0064       Set BC = "100 Decimal"
0D46  CD 10 0E          CALL "SUM"      Add Centuries
0D49  0E 0A             C = 0A          Set BC = "10 Decimal"
0D4B  CD 10 0E          CALL "SUM"      Add Decades
0D4E  0E 01             C = 01          Set BC = 1
0D50  CD 10 0E          CALL "SUM"      Add Years

BASE YEAR
0D53  01 DC 06          BC = 06DC       1756 Decimal
0D56  ED 42             Sub HL,BC       Get Year difference
0D58  E5                PUSH HL         Save difference

CENTURY ADJUST
0D59  1E 03             E = 3           Set cent. counter
0D5B  01 2C 00          BC = 2C         BC = 44 decimal
0D5E  ED 42       C1    Sub HL,DC       Dec. Count to 1800 Dec
0D60  38 0E             JRC "CYCLES"    Jump if 1756 - 1779
0D62  0E 64             C = 64          BC = 100 decimal
0D64  1D                Dec E           DEC. cent. counter
0D65  28 05             JRZ             If zero the cent. is leap year
0D67  CD 30 0E          Call DECDY      If not decrement one day to
                                        compensate
0D6A  18 F2             JR "C1"         Do for next century
0D6C  1E 04             E = 4           Reset Counter
0D6E  18 EE             JR "C1"         Do for next century

CYCLES
0D70  E1                POP HL          Recover year difference
0D71  A7                AND A,A         Reset Carry flag, if set
0D72  0E 1C             C = 1C          Set BC = 28
0D74  ED 42       CY1   Sub HL, BC      Reduce difference by 28 years
0D76  28 26             JRZ "SET LPYR"  Exactly 28 years diff. Zero
0D78  30 FA             JRNC "CY1"      Do again if result pos.
0D7A  09                Add HL, BC      If neg. add for remainder

LEAP YEARS
0D7B  7D                LD A, L         Put remainder in A
0D7C  D6 04       LPY1: Sub 04          Subtract leap years
0D7E  28 0A             JRZ "LP2"       Jump if Leap year
0D80  38 11             JRC "LP3"
0D82  6F                LD L, A         Store new Year difference
0D83  06 05             LD B = 05       Set day advance to 5
```

```
0D85  CD  1B  0E            Call "INCDY1"        Add 5 days to offset
0D88  18  F2                JR, "LPY 1"          Do again
0D8A  06  05        LPY2:   B = 5                Set Day advance to 5
0D8C  3E  29                A = 29 H             Set February day count to
0D8E  32  78  0E            (0E78), A            29
0D91  18  06                JR, "LPY 4"
0D93  3E  28        LPY 3:  A = 28 Hex.          Set February day count
0D95  32  78  0E            (0E78), A            to 28
0D98  45                    B, L                 Load Yr. difference
0D99  CD  1B  0E    LPY 4:  Call "INCDY 1"       Increment day offset as
                                                 required
0D9C  18  05                JR "MTH ADV"
```

SET LPYR

```
0D9E  3E  29                A = 29H              Set February day
0DA0  32  78  0E            (0E78), A            count to 29
```

MTH ADV

```
0DA3  01  3D  00            BC = 3D              Table length
0DA6  11  A3  0B            DE = 0BA3            CRT month location
0DA9  21  70  0E            HL = 0E70            Table start address
0DAC  1A            AV1:    A, (DE)              Load 1st letter
0DAD  ED  B1                CPIR                 Search
0DAF  20  53                JNZ "REPEAT"         If not found jump
0DB1  13                    INC DE               Step to next letter
0DB2  1A                    A, (DE)              Load 2nd letter
0DB3  BE                    CP, (HL)             Test for match
0DB4  28  03                JRZ "AV2"            If yes jump to 3rd letter
0DB6  1B                    DEC DE               Return to 1st letter location
0DB7  18  F3                JR "AV1"             Continue search
0DB9  23            AV2:    INC HL               Step to next table letter
0DBA  13                    INC DE               Step to next CRT letter
0DBB  1A                    A, (DE)              Load 3rd letter
0DBC  BE                    CP, (HL)             Test for match
0DBD  28  04                JRZ "AV3"            If Yes jump
0DBF  1B                    DEC DE               Step back to 1st letter
0DC0  1B                    DEC DE               on CRT
0DC1  18  E9                JR "AV1"             Continue search
0DC3  23            AV3:    INC HL               Step to next table location
0DC4  7E                    A, (HL)              Load Day Count in
0DC5  4F                    C, A                 Register C
0DC6  23                    INC HL               Step to next table location
0DC7  7E                    A, (HL)              Load day offset
0DC8  47                    B, A                 in Reg. B
0DC9  CD  1B  0E            CALL "INCDY 1"       Advance day offset
0DCC  69                    L,C                  Move day count to Reg. L
```

PRINT DAYS

```
0DCD  CD  F0  0E            CALL "DAYS"
```

DATES

```
0DD0  01  40  00            BC = 40              Line offset
0DD3  DD  21  17  09        IX = 0917            CRT start address
0DD7  DD  E5                PUSH IY              Save
0DD9  3A  0F  0E            A, (0E0F)            Load Day offset
0DDC  16  07                D = 7                Set days in week counter
0DDE  B7            D1:     OR A, A              Set Zero flag if zero
0DDF  28  17                JRZ "D6"             Jump when offset Zero
0DE1  3D                    DEC A                Dec offset
0DE2  15                    DEC D                Dec day count
0DE3  20  05                JRNZ "D2"
0DE5  CD  58  0E            CALL "NXTCOL"        Set IX to next column
0DE8  18  F4                JR "D1"              Do again
0DEA  DD  09        D2:     ADD IX: BC           Step to next line
0DEC  18  F0                JR "D1"              Do again
0DEE  15            D3:     DEC D                Dec. day count
0DEF  28  04                JRZ "D4"
0DF1  DD  09                ADD IX, BC           Step to next line
0DF3  18  03                JR "D6"
0DF5  CD  58  0E    D4:     CALL "NXTCOL"        Step to next column
0DF8  A7            D6:     AND A,A              Reset
0DF9  3C                    INC A
0DFA  27                    DAA
0DFB  F5                    PUSH AF              Save Reg A
0DFC  CD  40  0E            CALL PRINT           Print
0DFF  F1                    POP AF               Recover Reg. A
0E00  BD                    CP, L                Complete number of Days
0E01  20  EB                JRNZ D3              Do again
```

TIDY

```
0E03  E1                    POP HL               Clear Stack
0E04  C3  0C  0D    REPEAT  JP "INIT 1"          Go for next entry
0E0F  OFFSET REGISTER
```

SUBROUTINES

SUM:

```
0E10  13                    INC DE               Step to next location
0E11  1A            SUM 1:  A, (DE)              Load character
0E12  E6  0F                AND "0F"             Strip ASCII weighting
0E14  C8            SUM 2:  RZ
0E15  09                    ADD HL, BC           Add Hex weighting
0E16  3D                    DEC A
0E17  18  FB                JR "SUM 2"           Repeat till A = Zero
```

INCDY:

```
0E1A  05                    DEC B                Decrement counter
0E1B  F5                    PUSH AF              Save Reg. A
0E1C  3A  0F  0E    INCDY1: A, (0E0F)            Load day offset
0E1F  80                    ADD B                ADD Counter
0E20  FE  07        INCDY2: CP = "7"             Is day offset > 7
0E22  38  04                JRC "INCDY 3"
0E24  D6  07                SUB "7"              If Yes Sub 7 and
0E26  18  F8                JR "INCDY 2"         test again.
0E28  32  0F  0E    INCDY 3: (0E0F), A           Store new offset
0E2B  F1                    POP AF               Recover Reg. A
0E2C  C9                    RTN                  Rtn.
```

DECDY:

```
0E30  3A  0F  0E            A, (0E0F)            Load day offset
0E33  B7                    OR A, A              Test for Zero
0E34  20  02                JRNZ "DECDY1"
0E36  3E  07                A = 07               Replace '0' with '7'
0E38  3D            DECDY 1: DEC A               Decrement Counter
0E39  32  0F  0E            (0E0F) A             Store new offset
0E3C  C9                    RTN                  Return
```

PRINT

```
0E40  F5                    PUSH AF              Save Reg. A
0E41  1F                    RRA
0E42  1F                    RRA                  Move the most sig bits
0E43  1F                    RRA                  (4 – 7) to position (0 – 3)
0E44  1F                    RRA
0E45  E6  0F                AND A, "0F"          Remove bits 4 – 7
0E47  28  05                JRZ "P1"             If Zero ignore
0E49  C6  30                ADD A,30             Add ASCII weighting
0E4B  DD  77  00            (IX+0), A            Print A
0E4E  F1            P1.     POP FL               Recover A
0E4F  E6  0F                AND A, 30            Remove bits 4 – 7
0E51  C6  30                ADD A, 30            Add ASCII weighting
0E53  DD  77  01            (IX + 1), A          Print A in next location
0E56  C9                    RTN
```

INC CRT

```
0E58  FD  E1                POP IY               Save bottom of stack
0E5A  DD  E1                POP IX               Recover IX base
0E5C  DD  23                INC IX
0E5E  DD  23                INC IX               Increment IX 5 times to
0E60  DD  23                INC IX               start at next
0E62  DD  23                INC IX               column
0E64  DD  23                INC IX
0E66  16  07                D = 7                Reset counter
0E68  DD  E5                PUSH IX              Save IX new base
0E6A  FD  E5                PUSH IY              Restore bottom of stack
0E6C  C9                    RTN                  RTN
```

TITLE

```
0EB4  EF  47  52  45                             Gregorian Calendar
0EB8  47  4F  52  49
0EBC  41  4E  20  20
0EC0  43  41  4C  45
0EC4  4E  44  45  52
0EC8  00  C9
```

INSTRUCTIONS

```
0ECA  EF  1F  20  20                             INPUT MONTH AND
0ECE  49  6E  70  75                             YEAR >
0ED2  74  20  4D  6F
0ED6  6E  74  68  20
0EDA  61  6E  64  20
0EDE  59  65  61  72
0EE2  20  3E  20  00
0EE6  C9
```

DAYS

```
0EF0  EF  1F  1F  1F                             Scroll 5 times
0EF4  1F  1F  20  20                             SUNDAY
0EF8  53  55  4E  44                             MONDAY
0EFC  41  59  1F  20                             TUESDAY
0F00  20  4D  4F  4E                             WEDNESDAY
0F04  44  41  59  1F                             THURSDAY
0F08  20  20  54  55                             FRIDAY
0F0C  45  53  44  41                             SATURDAY
0F10  59  1F  20  20                             Scroll 4 times
0F14  57  45  44  4E
0F18  45  53  44  41
0F1C  59  1F  20  20
0F20  54  48  55  52
0F24  53  44  41  59
0F28  1F  20  20  46
0F2C  52  49  44  41
0F30  59  1F  20  20
0F34  53  41  54  55
0F38  52  44  41  59
0F3C  1F  1F  1F  1F
0F40  00  C9
```

TABLE

```
0E70  4A  45  4E  31  04                         JAN  31  4
0E75  46  45  42  28  00                         FEB  28  0
0E7A  4D  41  52  31  00                         MAR  31  0
0E7F  41  50  52  30  03                         APR  30  3
0E84  4D  41  59  31  05                         MAY  31  5
0E89  4A  55  4E  30  01                         JUN  30  1
0E85  4A  55  4C  31  03                         JUL  31  3
0E93  41  55  47  31  06                         AUG  31  6
0E98  53  45  50  30  02                         SEP  30  2
0E9D  4F  43  54  31  04                         OCT  31  4
0EA2  4E  4F  56  30  00                         NOV  30  0
0EA7  44  45  43  31  02                         DEC  31  2
```

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Malcolm Banthorpe

CONLAN

String your programs together with our new language.

This article describes a programming language specifically designed to facilitate string handling in certain applications called CONLAN (after CONversational LANguage). In effect it places at the disposal of the programmer a number of useful subroutines which are accessed by means of symbolic commands.

Language Description

This description may be applied to any interpretive high level language. CONLAN could be described as 'super-high-level' or 'second generation' as it is written in BASIC. As a consequence its operation may easily be understood by reference to the program listing of the Interpreter and it may be extended or tailored to suit the needs of the individual user. Further, its use is not limited to any particular processor and it may be implemented on *any* machine having the normal string handling commands of an 8K or larger BASIC.

The form taken by the CONLAN statements, and their syntax, is very similar to that of Pilot and it can be considered as a 'Tiny' version of that language. Possible applications of the Interpreter include Computer Assisted Learning (CAL) and games of a conversational nature.

Implementation And Use

A typical CAL program, having presented some instructional text, poses a question, accepts a response and then branches to a further question or statement depending on whether or not the response was correct. The correct answer may well be embedded in a sentence and there may be more than one form of acceptable response. For instance, in a simple arithmetic tuition program, the correct answer to the question 'If you have three apples and I take one, how many are left?' could take the following forms:

a) TWO
b) 2 APPLES
c) TWO ARE LEFT
d) I WOULD HAVE 2 APPLES

These are just some of the forms the correct answer may take. To write a program which can detect the correct answer in all the most likely forms is possible directly in BASIC, but can easily lead to complex, convoluted programs that are difficult to debug or modify. CONLAN offers a means of writing these sort of programs which can be used even by relatively inexperienced programmers. It is desirable that the computer should have at least 8K user RAM as the Interpreter occupies about 2K (not including arrays).

The available program commands are as follows:-

T/ - Type. Prints whatever appears following the '/'. This may be literal text or may contain string variables, which are denoted by the suffix '$'.
e.g. T/THiS WILL BE PRINTED
T/HELLO NAME$

A/ - Accept input. If the command is followed by a variable name, the input will be stored under that name and may subsequently be printed in T/ statements.
e.g. A/NAME

M/ - Match. Checks the last input to see of it contains any of the words following this command. Alternatives are seperated by a semicolon.
e.g. M/TWO;2;TO;TOO

J/ - Jump. Transfers program execution to the statement preceded by the label following the command.
e.g. J/START

R/ - RETURN. Returns program execution to the line following the last jump. J/ and R/ together permit one level of subroutine.

E - Exit. Terminate program.

All of the above commands except E may be modified by the addition of the conditioners Y and N. Their effect is to make the execution of the command conditional on the outcome of the last match statement. For example, JN/START will only transfer program execution to the line labelled START if the result of the last match was negative. If positive, the command is ignored. TY/THAT IS CORRECT will only print 'THAT IS CORRECT' if the result of the last match is positive.

An Example

The following program is trivial but will serve to illustrate how the commands are exployed:

```
 1  START*T/HELLO WHATS YOUR NAME?
 2  A/NAME$
 3  T/WELL NAME$ HOW ARE YOU?
 4  LOOP*A/
 5  M/AWFUL;LOUSY;NOT
 6  TY/SORRY TO HEAR THAT
 7  JY/END
 8  M/GOOD;WELL;FINE
 9  TN/I DIDNT UNDERSTAND THAT
10  TN/COULD YOU PUT IT ANOTHER WAY?
11  JN/LOOP
12  T/IM GLAD TO HEAR THAT NAME$
13  END*E
```

The Following should be noted:

a) Line numbering is automatic when the program is typed in. Jump destinations are however labels, which may be assigned as required.

b) Where a label preceeds a command, it must be followed by a '*' to seperate it from the command.

c) All commands except 'E' have the suffix '/'

d) Commas and colons cannot be used in T/ statements or included in a typed in response. They would result in any text following them being ignored and an 'EXTRA IGNORED' message.

System Commands

The available control commands are as follows:-

WRITE - Allows a program to be typed in. First, the computer will ask for INCREMENT?. This sets the increment between line numbers, which, as mentioned above, appear automatically and do not have to be typed. It will normally be set to one (see later). The first line number to appear will be 1 if the increment is 1, 2 if the increment is 2 and so on. A program statement may then be typed in and terminated with the carriage return. The next line number will appear and the next line can be typed. This will continue until an 'E' is typed denoting the end of the program. The Interpreter will now be ready to accept another control command.

LIST - Allows the program to be listed. First asks WHICH LINES? The numbers of the first and last lines to be displayed should be typed in, seperated by a comma. e.g. 1,10 will list lines one to ten inclusive.

EDIT - Allows a line or lines to be changed. Also allows extra lines to be inserted if the increment was initially set to two or more. First asks FROM WHICH LINE? Once a line number has been entered it will be displayed on the next line and the new statement can be typed in. Following carriage return, the next line number is displayed regardless of what the increment may have previously been set to. A further line may now be typed in. Alternatively, if a control command is typed and entered, the Interpreter exits edit mode and the new control command will be obeyed.

RUN - Executes the program until an 'E' command is reached. The message 'END OF PROGRAM' is then displayed and the interpreter is ready to accept a new control command.

Interpreted Interpreter

The CONLAN Interpreter uses an array, C$, to store the lines of the program. The dimension of this array is set to 200 in the listing as shown and allows up to 200 lines of program if the increment is set to one, 100 if set to two, 40 if set to five and so one. All 200 lines are available via the EDIT command. On a computer with less than 8K of RAM it may be desirable to dimension C$ at less than 200 in order to avoid running out of string array space. Arrays J$ and J are set to permit up to 20 labels. Arrays S$ and N$ permit up to 20 string variables if dimensioned as shown. The dimensions of all these arrarys may be varied to suit individual requirements, within the limits imposed by available RAM.

Permanent storage of the CONLAN programs is possible if your computer has the facility to save arrays on tape or disc. All arrays exccept A$ and B$, plus the variables K and S can be saved. Ideally the control command repertoire of the Interpreter should be extended to include save and load routines appropriate to your computer.

The program was written for use on an ITT 2020, but the BASIC has been kept as standard as possible so that there should be little problem in running the Interpreter on other machines. The only expression which may possibly be unfamiliar is CLS. This is used to clear the VDU screen at several points in the listing. Any other expression or routine which performs this function and which is appropriate to your machine may be substituted. In order to optimise the speed of operation of the Interpreter, an input is broken down into seperate words by subroutine 1000 and stored in string array B$, where they may subsequently be compared with words contained in match statements. Note that this means that a match statement cannot be used to search for a phrase directly, only single words. Consecutive match statements must be employed if a phrase is to be sought. For example to detect whether an input contains the phrase 'TWO APPLES' it is necessary to search seperately for 'TWO' and 'APPLES', eg:

```
A/
M/TWO
MY/APPLES
TY/THATS RIGHT
```

As it stands, the Interpreter does not permit any numerical computation. The number of available commands has deliberately been limited in order to minimise the memory requirement. If you have a requirement for numerical computation and have enough RAM, it would be possible either to add simple arithmetic commands and permit numerical variables or to allow BASIC routines to be called from CONLAN in a manner analogues to using a USR or CALL command to access machine code via BASIC.

Notes On The Interpreter

Use of arrays and variables:—

A$	- temporary store for string components separated by subroutine 1000
B$	- used to store separate words of an input string
C$	- lines of Conlan program
J	- line numbers where labels occur
J$	- labels
S$	- string variables
N$	- names assigned to string variables
B$	- seperator used in subroutine 1000
N	- line number during 'write' routine
P	- program counter during 'run'
TP	- line number where last jump occured
F	- general purpose flag
MF	- 'match' flag
S	- number of string variables used
K	- number of labels used
Y	- number of words in last input string
W	- number of alternative words to be matched

Other variables are used as temporary 'scratchpads' and loop counters. Subroutine 1000 is used several times in the Interpreter as a general purpose seperator routine. It takes a string A$ and a seperator B$ and splits A$ into a number of components which were seperated by B$. For example if A$ is a sentence and B$ is a space then subroutine 1000 will split A$ into seperate words, which will be stored in array A$. The number of words is Y.

CONLAN

```
 10 [CLS]:PRINT "CONLAN INTERPRETER V 2.1"
 80 DIM A$(20),B$(20),C$(200),J(20),J$(20),
    S$(20),N$(20)
 99 REM**COMMAND SELECT ROUTINE
100 PRINT
120 INPUT "COMMAND ?";A$
130 GOSUB 800
140 IF B=0 THEN 120
150 ON B GOTO 200,300,400,500
160 DATA WRITE,LIST,EDIT,RUN
199 REM**WRITE ROUTINE
200 PRINT : INPUT "INCREMENT ?";C
202 PRINT : N=0
205 IF A$ = "E" THEN 130
207 N = N + C
210 PRINT N;: INPUT A$
220 GOSUB 800 : IF B <> 0 THEN 150
240 B$ = "*" : GOSUB 1000
250 IF F = 0 THEN 270
260 K = K + 1 : J$(K) = A$(1) : J(K) = N
270 C$(N) = A$ : GOTO 205
299 REM**LIST ROUTINE
300 [CLS] : INPUT "WHICH LINES ?";L1,L2
310 FOR I = L1 TO L2 : PRINT I;" ";
320 FOR J = 1 TO K
330 FOR J(J) = I THEN PRINT J$(J);"*";
340 NEXT J
350 PRINT C$(I)
360 NEXT I
370 GOTO 100
399 REM**EDIT ROUTINE
400 PRINT : INPUT "FROM WHICH LINE ?";N
405 PRINT
410 C = 1 : GOTO 210
499 REM**RUN ROUTINE
500 [CLS]: P = 1
505 IF C$(P) = " " THEN 640
507 IF C$(P) = "E" THEN 700
510 J = 0 : T$ = " "
515 IF RIGHT$(C$(P),1) = "/" THEN C$ =
    LEFT$(C$(P),LEN(C$(P))-1) : GOTO 535
520 A$ = C$(P) : B$ = "/" : GOSUB 1000
530 C$ = A$(1) : T$ = A$
535 RESTORE
540 FOR I = 1 TO 4 : READ I$ : NEXT
550 FOR I = 1 TO 5 : READ I$
560 IF I$ = LEFT$(C$,1) THEN J = 1
570 NEXT I
580 IF J = 0 THEN 710
590 C$ = RIGHT$(C$,1)
600 IF C$ = "Y" AND MF = 1 THEN 630
610 IF C$ = "N" AND MF = 0 THEN 630
620 IF C$ = "Y" OR C$ = "N" THEN 640
630 ON J GOSUB 2000,2100,2200,2300,2400
    : IF E = 0 AND J = 4 THEN 100
640 P = P + 1
650 GOTO 505
660 DATA T,A,M,J,R
700 PRINT"END OF PROGRAM":GOTO 120
710 PRINT "ILLEGAL COMMAND IN LINE";P;
720 GOTO 120
799 REM**CHECK INPUT FOR CONTROL
    COMMAND KEYWORDS
800 B = 0 : RESTORE
810 FOR X = 1 TO 4
820 READ B$
830 IF A$ = B$ THEN B = X
840 NEXT X : RETURN
999 REM**SEPARATOR ROUTINE
1000 Y = 1 : F = 0
1010 L = LEN(A$)
1020 FOR X = 1 TO L
1030 IF MID$(A$,X,1) = B$ THEN F = 1 : GOTO
     1060
1040 NEXT X
1050 A$(Y) = A$ : RETURN
1060 A$(Y) = LEFT$(A$,X-1)
1070 A$ = RIGHT$(A$,L-X)
1080 Y = Y + 1 : GOTO 1010
1999 REM**T ROUTINE
2000 A$ = T$ : B$ = " " : GOSUB 1000
2005 PRINT
2010 FOR I = 1 TO Y
2020 IF RIGHT$(A$(I),1) <> "$" THEN PRINT
     A$(I);: GOTO 2060
2030 FOR M = 1 TO S
2040 IF N$(M) = A$(I) THEN PRINT S$(M);
2050 NEXT M
2060 PRINT " ";:NEXT I
2080 PRINT : RETURN
2099 REM**A ROUTINE
2100 PRINT : INPUT A$
2110 B$ = " "
2120 IF T$<> " " THEN 2160
2130 GOSUB 1000
2140 FOR I = 1 TO Y : B$(I) = A$(I) : NEXT :
     W = Y
2150 RETURN
2160 F = 0 : FOR M = 1 TO S : IF N$(M) = T$
     THEN F = 1 : T = M
2170 NEXT M
2180 IF F = 0 THEN S = S + 1 : T = S
2190 N$(T) = T$ : S$(T) = A$ : GOTO 2130
2199 REM**M ROUTINE
2200 B$ = ";" : A$ = T$ : MF = 0
2210 GOSUB 1000
2220 FOR A = 1 TO Y : FOR B = 1 TO W
2240 IF A$(A) = B$(B) THEN MF = 1
2250 NEXT B,A
2260 RETURN
2299 REM**J ROUTINE
2300 TP = P : E = 0
2310 FOR I = 1 TO K
2320 IF T$ = J$(I) THEN E = 1 : P J(I) - 1
2330 NEXT I
2340 IF E = 0 THEN PRINT "LABEL IN LINE";P;
     "NOT FOUND"
2350 RETURN
2399 REM**R ROUTINE
2400 P = TP : RETURN
```

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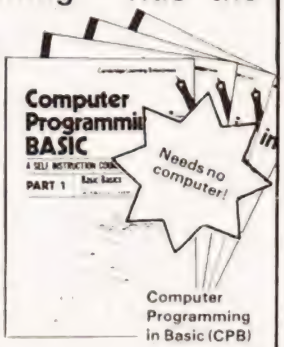

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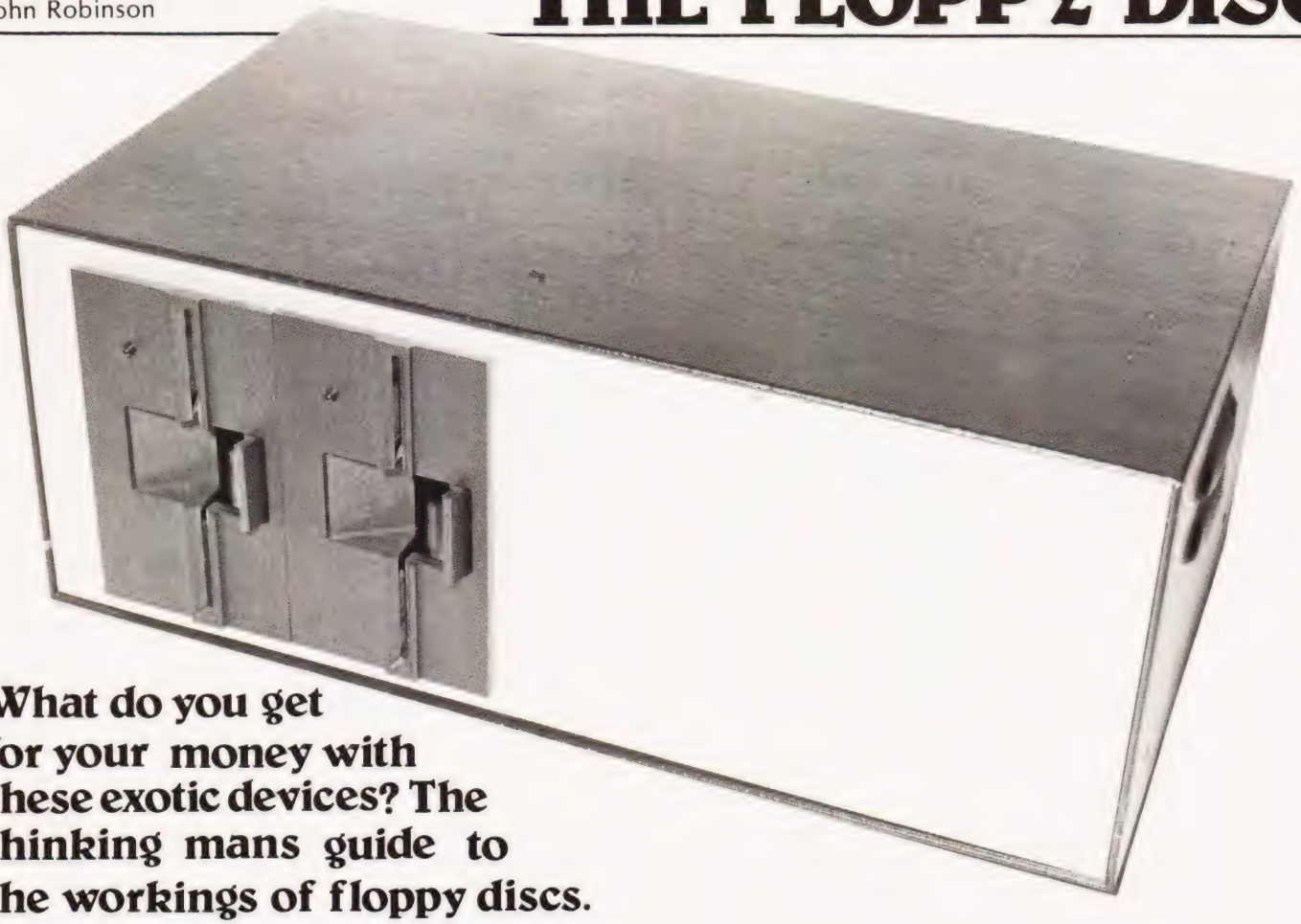
THE FLOPPY DISC

John Robinson



What do you get for your money with these exotic devices? The thinking mans guide to the workings of floppy discs.

One of the major peripherals small computer users save for is a floppy disc unit. The limitations of the cassette tape system found on many home computer systems soon make themselves felt when large quantities of data are to be handled. Where did the mini floppy discs come from and what can they do for you are two of the commonly asked questions that this article will attempt to answer.

Historical Overview

Around four years ago a major American disc manufacturer introduced the first mini floppy disc drive. Within twelve months they had delivered 10,000 units and they had acquired numerous imitators. The manufacturer was Shugart and its baby was the SA400, developed out of bigger (8") brothers such as the SA800. This drive and its many brethren offered an opportunity for home computer users to join their disc-based commercial counterparts at not unreasonable prices.

The first units offered only 35 tracks and a storage capacity of 110 kilobytes. Transfer rates were a mere 125 kilobytes per second and the track to track access times were around 40 mS.

Why The Mini Floppy

To understand the need for these devices it is helpful to discuss the shortcomings of serially organised storage devices such as cassette tapes. This medium is widely used and has a couple of problems that are common to its bigger brothers, the half inch commercial drives. These are: —

a) Search Time. If the bit of data required is at the far end of tape a finite time will pass before it is found, often several minutes.
b) Mechanics. If you wish to have high speed search facilities then you need a sophisticated drive system that is not found in cassettes.

The complexity of a tape machine required to emulate the mini floppy is very high and the data transfer rate is still slow in comparison-HP cartridge drives are better than most. The second point is that as far as the domestic market is concerned little or no software has been written to support file structures on cassette, and that which does exist is generally primitive.

The main attributes of a cassette system are lower cost per byte and a true high volume of data. Half a megabyte can easily be fitted onto a cassette and this is by no means the limit. Also in its favour is the fact that the medium is long lasting, it is often good for 10,000 passes across the heads with no loss of data. A bad mark against the system is the fact that the transfer times are slow. 4800 Baud (about 600 bytes per second) is possible with data tape and a good recorder but this needs a bandwidth of 16 kHz and not many domestic cassettes have this.

In strong contrast the machinery of the mini floppy is very simple consisting of a flexible disc covered with magnetic oxide that is rotated past a head (or

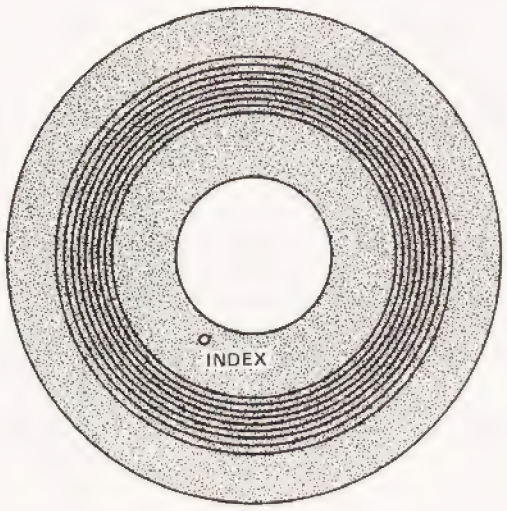


Fig.1. What it looks like inside the cover. The large hole is for the cone shaped drive spindle, the smaller index hole provides synchronisation.

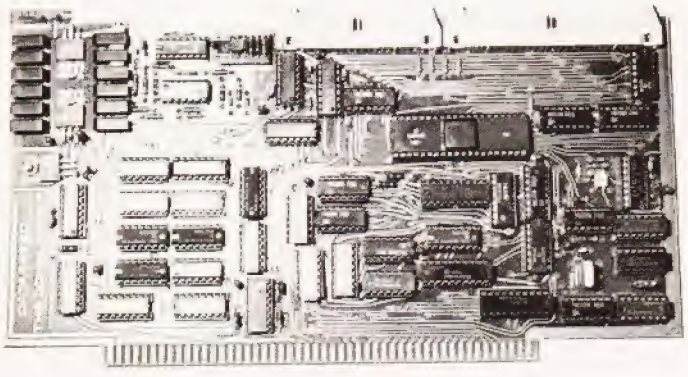
heads) like those in a tape recorder. These move radially, that's from the circumference to the axis, and the information is recorded in a series of concentric circles. The format can be seen in Fig.1.

Reading And Writing

The head must be positioned accurately over the track it is currently reading or writing. New designs are appearing that allow faster and more accurate alignment. The same magnetic gap in the head is used for both read and write as this eases the problem of alignment when reading a previously written track. This positioning is critical to allow for a maximum pickup of the read signal and to prevent the overwriting of other information on the disc.

Capacity of the mini floppy has been increased by doubling the density of recording the information and by using both sides. Information within a disc is divided up into sectors, each having typically 128 bytes of information for the programmer — the rest is used for pre-amble, addresses, check character and post-amble information.

The check character is usually made in the form of a cyclical redundancy character (CRC) and is a "hash" total of the information in the sector.



A typical S100 disc controller card for OEM usage.

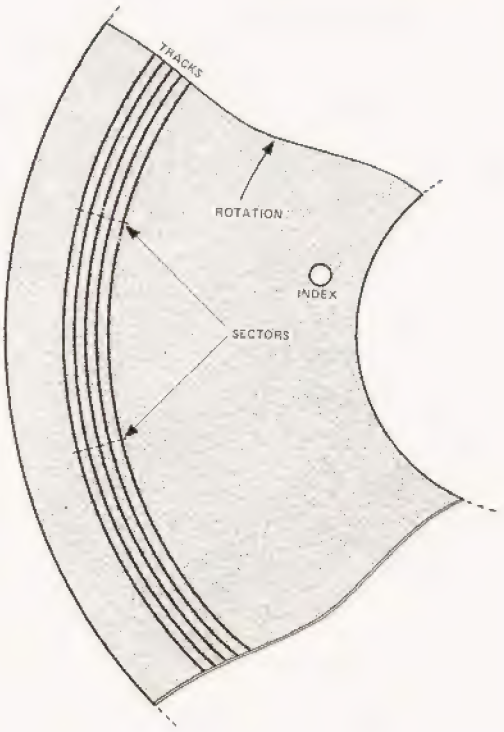


Fig.2. An expanded view of the disc surface showing the divisions. These are invisible to the human eye, just like the information on magnetic tape.

Control

Control of a floppy drive is considerably more complex from an electronic point of view than domestic tape recorders, but no more complex than a commercial tape system. Normal operation requires the following:-

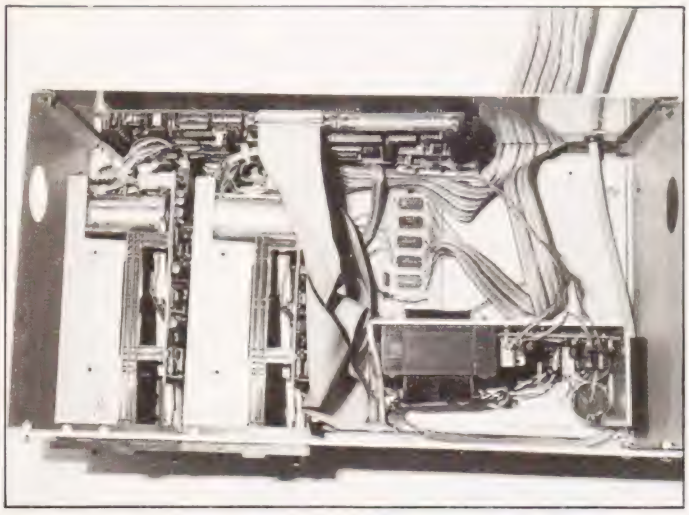
a) CRC generation and verification as this would "tie-up" the micro,
b) Read and write of single or multiple sectors,
c) Maintenance of track to track stepping and head settling times.

In order to accomplish these, certain registers will be needed to hold data, current track, current sector, current command and internal status. Among the other things that it must achieve on its own are Direct Memory Accesses (DMAs) with the micro.

It can be seen that this is by no means a simple device and only recently has it been integrated into LSI chips, thus bringing down the price. As an example of the moves made in the design we can look at the evolution of the double sided floppy. The problem was the media wear when both heads were loaded. The solution came with a design in which only one of the heads was loaded, the other remaining in situ. Designs have also varied the method of moving the heads from one track to another and these have included lead screws, pulley bands and spiral wheels — the fastest method is the pulley band and this is often found in the hard discs.

The recording method is digital, unlike the cassette, and with around 5500 flux changes to the inch it is possible to have densities of up to 48 tracks to the inch.

THE FLOPPY DISC



The insides of a typical dual 5¼" floppy disc system. This is used on Triton and runs under CP/M.

Laying It Down

The method of recording is important and there are many possible encoding schemes. Some allow very high densities but need complex electronics, some give high error immunity and others are simply cheap — and hence low density.

Very often the data will be recorded without all its clocks and it is here that the Phase Locked Loop (PLL) comes into its own. The PLL acts like a flywheel and during the pre-amble (which has all the clocks) it runs up to speed. During the data period which has only some clock information it supplies the missing parts.

Another phenomenon that occurs at higher densities is that of peak shift distortion. This needs even more electronics to straighten out the time shifts — new generation ICs are being equipped with the necessary logic.

The Users View

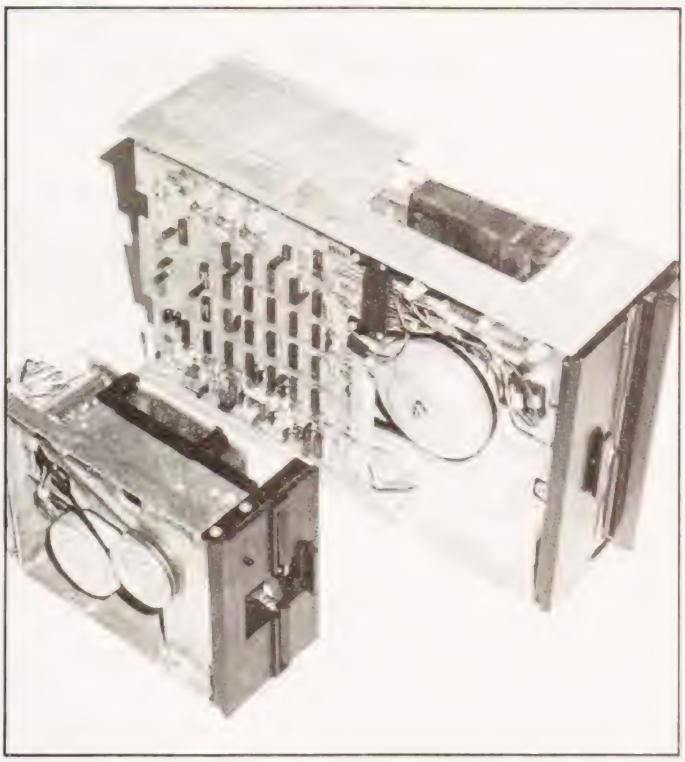
The part of the disc that the user sees is the operating system. An interesting example is CP/M. This can support named files. This means that you don't have to know the absolute track/sector location to find the file, only its name. Access to records within a file will generally be either sequential or random. Sequential storage is similar to a cassette and is slower than random. The speed of random access is controlled by an algorithm, these are numerous. Generally the more free space in the file, the better they work.

The Disc Operating System (DOS) will have a command processor giving commands such as:–

DIRectory. General or selective list of files
ERAse. Delete file or files
TYPe. Print out file contents
SAVE. File an area of memory onto disc
RENname. Change a given file name.

These and many others like PIP which act as utilities make up the DOS.

Other programs that are often supplied with a DOS are things like Editor/assemblers, BASIC compilers and debugging aids. The whole point of buying a DOS such as CP/M is that once tailored to your system, addresses of peripherals etc, you can run *any* CP/M based software.

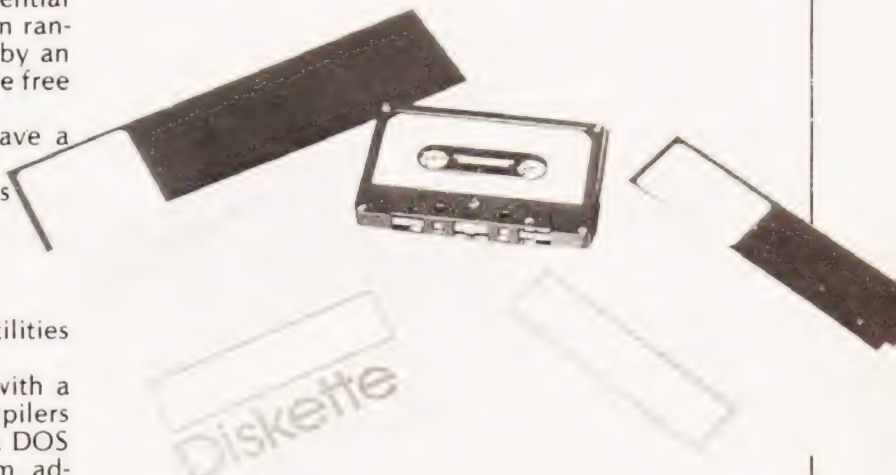


A size comparison between 8" and 5¼" drives, much of the visible electronics is soon to be "chipped".

Summary Of Benefits

The main advantage of a floppy is the speed of loading data and programs. A typical load of a BASIC interpreter from cassette is four minutes. This is why many manufacturers put it in ROM. Loading the same interpreter from a disc takes only seconds. With DOSs like CP/M becoming industry "standards", for all their faults, one is given a vast range of languages and utilities from a wide variety of software "houses".

If the prices of the drives put you off, some manufacturers and suppliers offer a veritable fortune in software on disc for the cost of the media alone. Typical offers are Editors, Assemblers, Utilities and Games so it's well worth bargain hunting.



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- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
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The display shows 32 characters by 24 lines.

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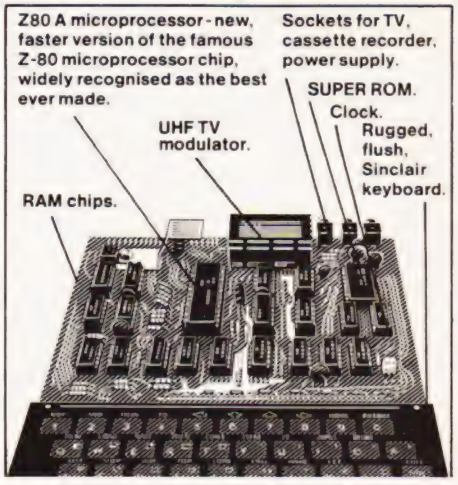

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MICROGRAPHICS REPORT

T.P. Goldingham

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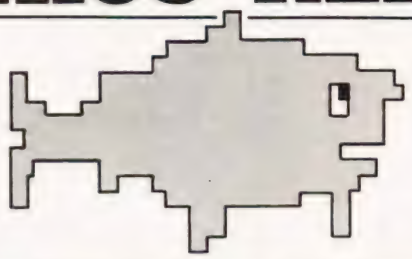

Fig 1. A specimen drawing produced by the unit.

The NASCOM 1 single board computer has been a popular machine and has acquired a large number of independently made add-ons. One of these items is a colour graphics board.....

Half and Half

I ordered the kit by telephone. Was it easy to build? I asked. 'Well, yes, but the modulator need some intricate soldering.' So I chickened out and paid an extra £4 to have the modulator made up. Sure enough, I found when it arrived that this part of the kit does comprise some fifty components on a small, about 3" square, board and I was quite relieved that this task had been done for me; though it should not be beyond the capacity of anyone who has successfully assembled a NASCOM.

Building Bricks

The main micrographics panel comprises eight ICs and about twenty other components, on a larger panel, and so presents no difficulty. Assembly instructions were clear, and my only problem was a discrepancy between the instructions, which refer to 7V5, and the circuit diagram, which shows +9 V. The colour modulator can be used for black and white operation, though I find that it does not give as clear a display on my portable black-and-white set as the original modulator (which is not disconnected, and can still be used).

A little more tricky is the task of connecting the micrographics board to the NASCOM. This requires a total of twenty connections. My NASCOM is mounted in a case, and has already been extensively modified, so working on the back of the board is an intricate operation. However, eleven of the connections are to the same chip (IC 17), and three more to Socket A. To minimise disturbance to the NASCOM board I removed the chip concerned and substituted a header, which I connected with the rainbow cable supplied to the standard socket. I was then able to make the micrographics connections to this socket, which was much easier to work on.

Kaleidoscopic Success

Eventually, all was complete, and the basic test pattern duly appeared. There are three preset potentiometers which have to be adjusted to obtain the best balance of the three primary colours. Having set these to my satisfaction, I keyed in the software and demonstration program supplied, and pressed Execute. The fascinating kaleidoscopic display that greeted my eyes fulfilled all my expectations, and made all the time and expense seem well worth while.

Let me explain a little more about how the William Stuart system works. It is what is known as a 'pixel' (picture select) system. This means that each of the NASCOM screen's character positions is broken up into four quarters, each of which can be separately switched to any of the seven colours; red, green, yellow, blue, mauve, cyan and white, or to black. The screen is thus divided into 96 x 32 positions. This gives wide flexibility in constructing all sorts of graphical effects. It is also possible to change the background colour.

Software Supplied

The software supplied comprises two subroutines which occupy from 0C50 to OCFF. The first, PLOT, colours one pixel to the desired colour, its position being determined by its x and y co-ordinates which are loaded into BC. The code for the colour is loaded in the register L'.

The second subroutine, which uses PLOT, draws a line between any two points. Again, co-ordinates are used, the start point being held in BC and the end in DE.

Suppose, then, that one wants to draw a picture. As an example, let's take the fish in Fig.1. This has to be built up by plotting a series of lines. To simplify the task, I wrote the subroutine given in Fig.2., which enables one simply to store all the co-ordinates in a table. The routine works through the table, picking up each pair of co-ordinates and placing it in BC or DE respectively before calling PLOT. CC followed by a code number causes a change of colour, while the displacements at the start of the table are added to the x and y co-ordinates to position the drawing anywhere on the screen.

Other possible applications include business charts and graphs, games such as Space Invaders, and the generation of mathematically designed colour patterns.

Subroutine 'Draw'

On entry, IX must be set to point to table of co-ordinates. Format is start x, start y, finish x, finish y; or CC followed by colour code number. IY points to displacements (x,y) which are added to co-ordinates to position drawing as desired.

```
D00  DD 7E 00   L1: LD A, (IX + 0)      Pick up first byte from table
D03  FE CC          CP CC               If colour change,
D05  20 0B          JRNZ +13 (L2)
D07  DD 23          INC IX
D09  D9             EXX
D0A  DD 6E 00       LD L', (IX + 0)     store next in L'
D0D  D9             EXX
D0E  DD 23          INC IX
D10  18 EE          JR -16 (L1)
D12  FE E7      L2: CP E7               If end of table,
D14  C8             RETZ                return
D15  FD 86 00       ADD A, (IY + 0)     Add displacement
D18  47             LD B, A             and store in B
D19  DD 7E 01       LD A, (IX + 1)      Pick up second byte
D1C  FD 86 01       ADD A, (IY + 1)     add displacement
D1F  4F             LD C, A             and store in C
D20  DD 7E 02       LD A, (IX + 2)
D23  FD 86 00       ADD A, (IY + 0)
D26  57             LD D, A             Repeat
D27  DD 7E 03       LD A, (IX + 3)      for
D2A  FD 86 01       ADD A, (IY + 1)     DE
D2D  5F             LD E, A
D2E  CD A1 0C       CALL LINE           Call subroutine to plot line
D31  DD 23          INC IX              Move
D33  DD 23                              on
D35  DD 23                              to
D37  DD 23                              next group
D39  18 C5          JR -57 (L1)         Repeat
```

Fig 2. The 'Draw' subroutine.

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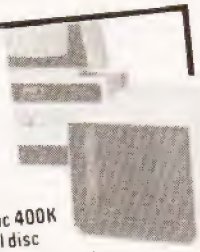

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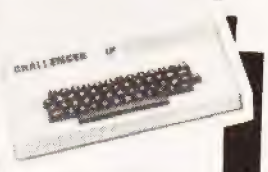

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Trevor Lusty

Subroutines make for elegant solutions, especially to last month's game problem.

Hands up all those who found lines 330 and 650 of the listings in the June issue 'of general interest'? Unfortunately, line 650 was not of general enough interest to be included, and line 330 contained an error! The point I was trying to make was this. On INPUT the PET prints a question mark, a space, and then positions the cursor on the third spot. The idea of line 330, and the elusive line 650, is to print two spaces, a dot and then THREE cursor lefts. The blinking cursor is then positioned over the dot which is accepted as input if only return is pressed; any other printing character will overwrite and therefore erase it.

First Home

The way to solve this problem is to work backwards. The shaded area of Fig.1 shows all the positions from which it is possible to move directly to zero. The objective is to force your opponent to make a move into this area.

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Fig.1. Where you can go from zero.

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Fig.2. How to get to 12 or 21.

If you can occupy either square 12 or 21 then this goal has been achieved. The shaded area of Fig.2 shows the positions from which you may get directly to these squares, and the new objective is to force your opponent into this area.

0	1	2	3	4	5	6	7	8	9
10	11	(12)	13	14	15	16	17	18	19
20	(21)	22	23	24	25	26	27	28	29
30	31	32	33	34	(35)	36	37	38	39
40	41	42	43	44	45	46	(47)	48	49
50	51	52	(53)	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	(74)	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Fig.3. The key squares in the problem.

By continuing this process we discover that the key squares are those shown in Fig.3. If we occupy one of these squares, then providing we do not make a mistake, we can always win.

Polite Note

It is worth noting at this point, that none of the key squares occur on the bottom row of the grid. You can only win by being polite and going second.

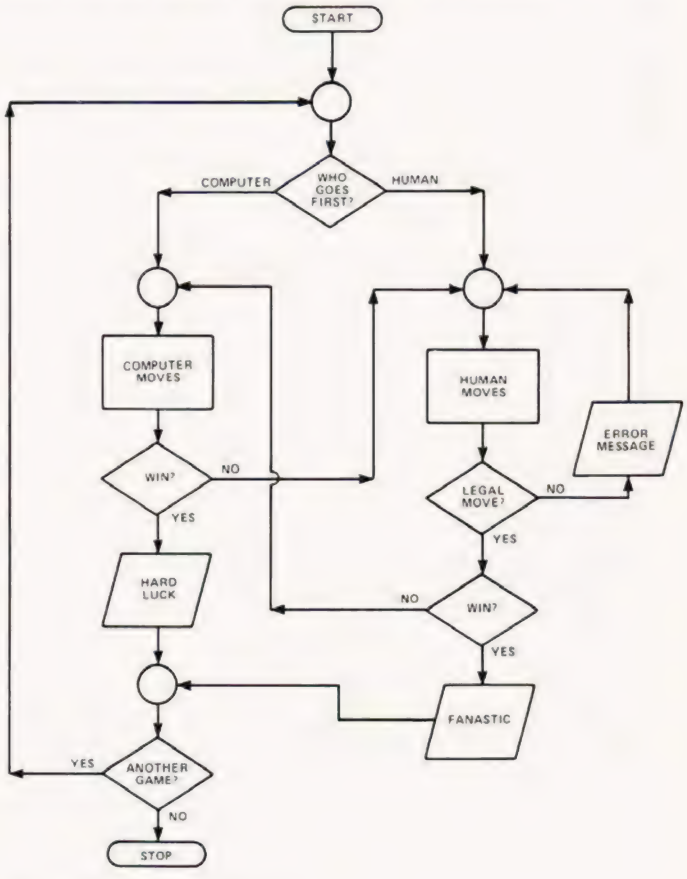

Fig.4. The outline flowchart.

Subroutines

When people start programming they often see little point in using subroutines, as twenty or thirty statements can be debugged with little effort. As they gain experience and become more ambitious their

programs become longer, and harder to understand. Many programs contain similar routines which must be entered every time they are required. This process is both error prone and time consuming, it is also unnecessary. Where a routine is self-contained or used at more than one place in a program it may be replaced by a subroutine. These routines may be debugged and then linked together for the final program.

It is not too difficult to write an outline flowchart for our problem, see Fig.4. This flowchart does not help us to code the sections of the program but it does help us to see which sections are required.

The sections of program which follow form a complete solution to our problem. I shall not work through the coding in line number order as subroutines may occur anywhere, but I shall tackle each piece of coding in what seems to be the most logical order. The program is written in fairly standard BASIC with as few PET nuances as possible.

Yes And No

Any interactive program is bound to ask questions with 'yes' and 'no' answers. The following subroutine allows both 'yes' and 'y' as affirmative replies, and 'no' and 'n' as negative responses. Communication with the calling routine is via flag A9, this is set to 1 for a positive reply and to 0 for a negative one. Note that the routine demands a correct response before the return can be executed.

```
3920 REM **** QUESTION SUBROUTINE ******
3940 LET A9=1
3960 INPUT A$
3980 IF A$=LEFT$("YES",LEN(A$)) THEN 4080
4000 IF A$=LEFT$("NO",LEN(A$)) THEN 4060
4020 PRINT "PLEASE ANSWER 'YES' OR 'NO' ";
4040 GOTO 3960
4060 LET A9=0
4080 RETURN
```

Legal Move

We can divide the check for a legal move into two parts. First we can check that the number input is both an integer an within the range required.

```
2860 REM ***** SUBROUTINE TO CHECK *****
2880 REM ***** FOR VALID INTEGER. *****
2900 PRINT " - - -NEXT TRY";
2920 INPUT X1
2940 IF X1<0 THEN 3120
2960 IF X1=INT(X1) THEN 3040
2980 PRINT "SORRY - - - ONLY WHOLE NUMBERS ARE"
3000 PRINT "ALLOWED";
3020 GOTO 2900
3040 IF X1<100 THEN 3120
3060 PRINT "YOUR NUMBER MUST BE LESS"
3080 PRINT "THAN 100";
3100 GOTO 2900
3120 RETURN
```

Then we must check that the number input moves towards zero. In the following section, location M holds the difference between the current position and the number input. Not only must this not be negative, but the units digit must be less than or equal to the units digit of the current position. Communication with the calling program is again via flags, this time F9 is used, 1 signifying a valid move and 0 an invalid move.

```
4100 REM ***** SUBROUTINE TO CHECK *****
4120 REM ***** THAT MOVE IS LEGAL. *****
4140 LET F9=1
4160 IF M<0 THEN 4320
4180 LET T9=INT(M/10)
4200 LET U9=M-10*T9
4220 IF U9>X-10*INT(X/10) THEN 4320
4240 IF U9=0 THEN 4340
4260 IF T9=0 THEN 4340
4280 LET D9=T9-U9
4300 IF D9=0 THEN 4340
4320 LET F9=0
4340 RETURN
4360 END
```

Printing intermediate positions of the board requires the values T9 and U9, and the subroutine given above is called just prior to printing in order to set them. The printing routine uses string functions for consistent output and N$ is initialised as the string 'b0123456789' before the following subroutine is called. Line 3740 allows blanks rather than zeros to be printed.

```
3660 REM ***** PRINT THE BOARD NUMBERS *****
3680 PRINT
3700 PRINT
3720 FOR B7=1 TO T9+2
3740 IF B7=2 THEN 3860
3760 FOR B9=2 TO U9+2
3780 PRINT MID$(N$,B7,1);MID$(N$,B9,1);" ";
3800 NEXT B9
3820 PRINT
3840 PRINT
3860 NEXT B7
3880 PRINT
3900 RETURN
```

The last subroutine is the one for the instructions, note that it calls the board printing routine within its own coding, this is an example of a 'nested' subroutine.

```
3140 REM ***** PRINT THE INSTRUCTIONS *****
3160 PRINT
3180 PRINT "THIS IS A GAME BASED ON A 10 BY 10"
3200 PRINT "BOARD NUMBERED IN THE FOLLOWING
     WAY:-"
3220 GOSUB 3700 :REM *** PRINT BOARD ***
3240 FOR DL=1 TO 5000:NEXT DL
3260 PRINT "[CLS]"
3280 PRINT "THE FIRST PLAYER BEGINS BY PLACING A"
3300 PRINT "PEG IN ANY SQUARE ON THE BOTTOM ROW,"
3320 PRINT "AND THE OBJECT OF THE GAME IS TO MOVE"
3340 PRINT "IT 'HOME' TO SQUARE ZERO."
3360 PRINT
3380 PRINT
3400 PRINT "WE TAKE TURNS AT MOVING THE PEG, AND"
3420 PRINT "THE WINNER IS THE PLAYER WHO MAKES
     THE"
3440 PRINT "FINAL JUMP. YOU MAY MOVE THE PEG"
3460 PRINT "HORIZONTALLY, VERTICALLY OR
     DIAGONALLY"
3480 PRINT "BY AS MANY SQUARES AS YOU WISH, BUT"
3500 PRINT "ONLY MOVES TOWARDS ZERO ARE
     PERMITTED."
3520 PRINT
3540 PRINT
3560 PRINT "YOU MAY CONCEDE THE GAME AT ANY
     POINT"
3580 PRINT "BY ENTERING A NEGATIVE NUMBER."
3600 PRINT
3620 PRINT
3640 RETURN
```

Computer's Move
How to hide the computer's move does not have a unique solution. I chose to use the function P(9-P)-13 which returns the values 1, 5 and 7 when P is 2, 3 and 4. If these values are combined they give the key square numbers 12, 21, 35, 53, 47, 74. The following section of coding uses the legal move routine to find whether the computer can a) win, b) move to a key square. If neither of these is possible the computer deducts one from the current position.

```
2400 REM ***** SELECT COMPUTER'S MOVE *****
2420 LET M=X
2440 LET N=0
2460 GOSUB 4140 :REM *** LEGAL ? ***
2480 IF F9=0 THEN 2560
2500 PRINT "HARD LUCK - - - I MOVE HOME TO ZERO
     AND"
2520 PRINT "WIN";
2540 GOTO 2260
2560 FOR P=4 TO 2 STEP -1
2580 LET T=P*(9-P)-13
2600 LET N=P+10*T
2620 LET M=X-N
2640 GOSUB 4140 :REM *** LEGAL ? ***
2660 IF F9=1 THEN 2800
2680 LET N=T+10*P
2700 LET M=X-N
2720 GOSUB 4140 :REM *** LEGAL ? ***
2740 IF F9=1 THEN 2800
2760 NEXT P
2780 LET N=X-1
2800 LET X=N
2820 PRINT "I SHALL MOVE THE PEG TO SQUARE";X
2840 GOTO 1820
```

The rest of the program is straightforward, it starts by initialising some variables and asking whether instructions are required.

```
1180 REM ***** SET-UP AND START *****
1200 T9=9
1220 U9=9
1240 LET N$="0123456789"
1260 PRINT "[CLS]THIS IS THE GAME OF 'FIRST-HOME'"
1280 PRINT
1300 PRINT "DO YOU WANT INSTRUCTIONS";
1320 GOSUB 3940 :REM *** QUESTION ***
1340 IF A9=0 THEN 1380
1360 GOSUB 3160 :REM *** INSTRUCTIONS ***
1380 PRINT
```

We can now ask if the opponent wishes to start, and if he does we must check that his first move is valid.

```
1400 REM ***** DOES OPPONENT WANT *****
1420 REM ***** TO START. *****
1440 PRINT "DO YOU WANT TO START ";
1460 GOSUB 3940 :REM *** QUESTION ***
1480 PRINT
1500 IF A9=0 THEN 1780
1520 PRINT "OK - - - YOU START - - -";
1540 PRINT "WHERE DO YOU WISH"
1560 PRINT "TO PLACE THE PEG";
1580 GOSUB 2920 :REM *** INPUT NO. ***
1600 PRINT
1620 LET X=X1
1640 IF X>89 THEN 2420
1660 PRINT
1680 PRINT "YOU ARE ONLY ALLOWED TO START ON THE"
1700 PRINT "BOTTOM ROW !!!"
1720 PRINT "YOUR NUMBER MUST BE BETWEEN 90 AND
     99"
1740 PRINT
1760 GOTO 1540
```

If the computer has first move it chooses randomly between the range 93 to 97. The opponent's move is then input and checked.

```
1770 REM ***** COMPUTER GOES FIRST *****
1780 LET X=93+INT(5*RND(1))
1800 PRINT "OK - - - I'LL START IN SQUARE";X
1820 LET M=X
1840 GOSUB 4140 :REM *** LEGAL ? ***
1860 GOSUB 3680 :REM *** PRINT BOARD ***
1880 PRINT "TO WHICH SQUARE DO YOU WISH"
1900 PRINT "TO MOVE";
1920 GOSUB 2920 :REM *** INPUT NO. ***
1940 PRINT
1960 IF X1>=0 THEN 2040
1980 PRINT "I'M SORRY YOU GAVE UP - - - I WIN BY"
2000 PRINT "DEFAULT";
2020 GOTO 2260
2040 LET M=X-X1
2060 GOSUB 4140 :REM *** LEGAL ? ***
2080 IF F9=1 THEN 2160
2100 PRINT "I'M SORRY - - - YOU CAN'T MOVE THERE"
2120 PRINT "I HOPE YOU'RE NOT TRYING TO CHEAT !!!"
2140 GOTO 1820
2160 LET X=X1
2180 IF X<CLS>0 THEN 2420
```

Finally we must check for a win and ask if another game is required.

```
2200 REM ***** HUMAN WINS - - - ANOTHER GAME ?
     *****
2220 PRINT "***** FANTASTIC *****"
2240 PRINT "YOU BEAT ME";
2260 PRINT " - - - DO YOU WANT"
2280 PRINT "ANOTHER GAME";
2300 GOSUB 3940 :REM *** QUESTION ***
2320 IF A9=1 THEN 1440
2340 PRINT
2360 PRINT "THANKS FOR THE GAME - - - BYE BYE FOR
     NOW"
2380 STOP
```

Random Dice
Computer simulation plays a large part in our modern world, and random number generators play a large part in computer simulation. That's why different economists can come up with different predictions and still claim to be right. So, before we all get Clegged, why not try:-

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1, 3, 5, 7, 9, 11
1, 2, 2, 3, 3, 3
2, 3, 5, 7, 11, 13

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An outstanding personal computer kit

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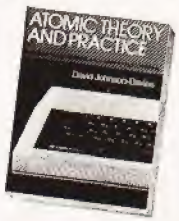
The ATOM – a definitive personal computer. Simple-to-build, simple-to-operate. But a really powerful full-facility computer. And designed on an expandable basis. You can buy a superb expanded package now – tailored to your needs. Or, you can buy just the standard Atom kit, and, as you grow in confidence and knowledge, add more chips. No need to replace your equipment. No need to worry that your investment will be overtaken by new technology. As you need more power, more facilities, you can add them!

*The picture shown demonstrates mixed graphics and characters in three shades of grey provided by the Standard Atom.

The standard ATOM kit includes:

● Full sized QWERTY keyboard ● Rugged polystyrene case ● Fibreglass PCB ● 2K RAM ● 8K ROM ● 23 integrated circuits ● Full assembly instructions including tests for fault-finding. (Once built, connect it to any domestic TV and power source) ● Power requirement: 8V at 800 M A. ATOM power unit available. See coupon. PLUS FREE MANUAL written in two sections – teach yourself BASIC and machine code for those with no knowledge of computers, and a reference section giving a complete description of the ATOM's facilities. All sections are fully illustrated with example programs.



The ATOM concept

Adding chips into sockets on the PCB allows you to progress in affordable steps to large-scale expansion. You can see from the specifications that the RAM can be increased to 12K allowing high resolution (256 x 192) graphics. Two further ROM chips, e.g. maths functions, can be added directly to the board giving a 16K capacity. In addition to 5 I/O lines partly used by the cassette interface, an optional VIA device can provide varied I/O and timer functions and via a buffer device allow direct printer drive. An optional module provides red, green and blue signals for colour. An in-board connector strip takes the ATOM communications loop interface. Any number of ATOMs may be linked to each other – or to a master system with mass storage/ hard copy facility. Interface with other ACORN cards is simplicity itself. Any one ACORN card may be fitted internally.

So you can see there are a vast number of modular options and additions available, expanding with your ability and your budget.

The ATOM hardware includes:

● Memory from 2K to 12K RAM on board (up to 35K in case) ● 8K to 16K ROM (two 4K additions) ● 6502 processor ● Video Display allows high resolution (256 x 192) graphics and red, green and blue output ● Cassette Interface – CUTS 300 baud ● Loudspeaker allows tone generation of any frequency ● Channel 36 UHF Modulator Output ● Bus output includes internal connections for Acorn Eurocard.

The ATOM software includes:

● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 32-bit integer variables ● 27 additional arrays ● random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● LINK to machine-code routines ● PLOT DRAW and MOVE.

ACORN COMPUTER 4a Market Hill, CAMBRIDGE CB2 3NJ

Your ACORN ATOM may qualify as a business expense. To order complete the coupon below and post to Acorn Computer for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied. **All components are guaranteed with full service/repair facility available.**

Please send me the following items:

Quantity	Item		Item price inc. VAT+p&p	TOTALS
	ATOM KIT 8K + 2K (MIN)		@ £140.00	
	ATOM ASS 8K + 2K (MIN)		@ £174.50	
	ATOM KIT 12 + 12K (MAX)		@ £255.00	
	ATOM ASS 12 + 12K (MAX)		@ £289.50	
	1K RAM SETS		@ £11.22	
	4K FLOATING POINT ROM		@ £23.30	
	PRINTER DRIVE	6522 VIA	@ £10.35	
		Buffer (LS 244)	@ £3.17	
	MAINS POWER SUPPLY (1.5 amps)		@ £10.20	
			TOTAL	

To: Acorn Computer Ltd., 4a Market Hill, CAMBRIDGE CB2 3NJ

I enclose cheque/postal order for £

Please debit my Access/Barclaycard No.

Signature

Name (Please print)

Address

Telephone No.

Registered No: 1403810. VAT No: 215 400 220 CT/8

Access BARCLAYCARD VISA

computing today

What to look for in our September issue, on sale August 8th.

PASCAL, A FALSE IDOL? Is this much mooted language really going to be the saviour of small systems? One of our contributors holds some very controversial views on the topic and airs them through our pages next month. If you are considering which of the many computer languages to learn then this is essential reading.

CHEAP FILING

If your business doesn't justify the expense of floppy discs then our special feature on cassette filing is an absolute must. Complete with the necessary software it allows you to take full advantage of the vast storage capacities of magnetic tape and still be able to find what you want when you need it. Ideal for the really small business or even just the tidy minded.

SORT IT OUT Have you ever struggled with lists of names or places and tried to re-arrange them into alphabetical order? Do you wish that business program would sort things out before it gave you the latest sales figures? Well with this smart little piece of software, which can be used as either a subroutine or as a self-standing program, you too can have nicely ordered printouts.

EXCLUSIVE MICRO REVIEW

Once again the valiant souls at CT have sweated long hours through the night to bring you an exclusive. This time we are giving away no clues but, suffice to say, that the system appears to offer both excellent features and value for money in a very neat package. To find out the secrets of the latest addition to the British micro scene book your copy now, miss it and you'll regret it.

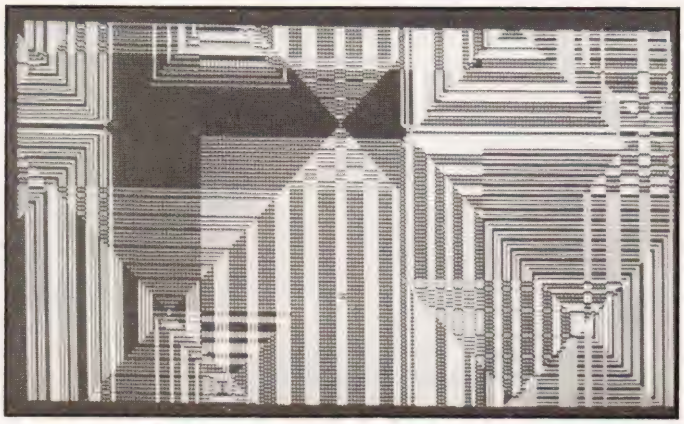
DIALECTS If you are confused between "Integers" and "Microsofts" and "Extendeds" (among others) then our dissertation on BASIC dialects will certainly be of invaluable assistance. Be baffled no longer by the salesperson's use of programming jargon, become fluent in all the variations on the BASIC theme.

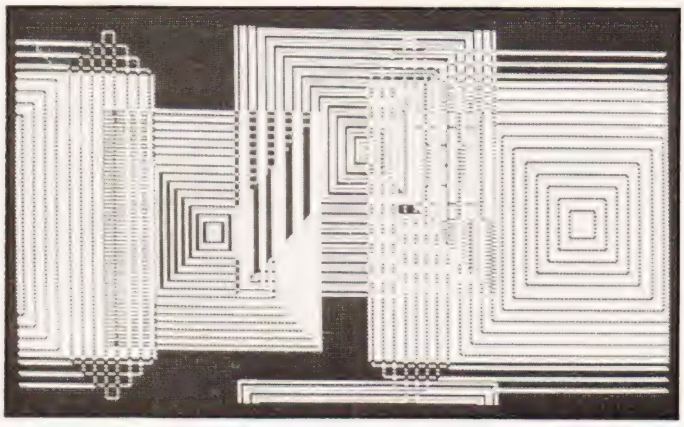
Malcolm Banthorpe

COMPUTER GRAPHICS

Graphics vary from system to system, we show you how to get the best out of yours, and illustrate the point with examples of artwork generated by a system, using only a square as a design element.

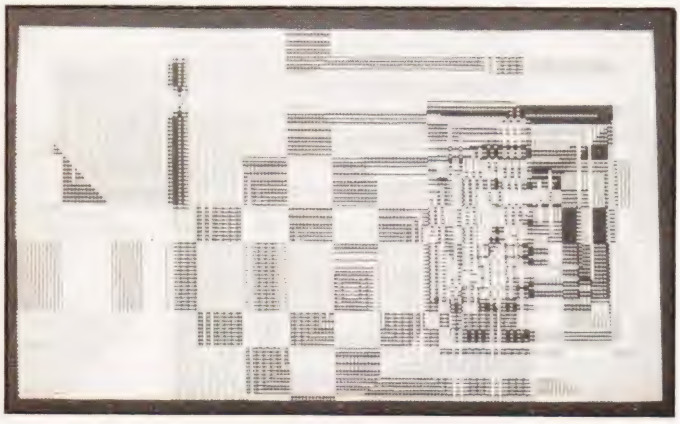
Early electronic computers were designed to accept data from paper tape, magnetic tape or a set of punched cards and to provide an output to a similar medium which would, ultimately, provide readable hard copy via a printer. More recently, with the advent of the microcomputer, the use of a Visual Display Unit or "glass teletype" has become the norm as the primary input/output device, often with a printer as a parallel output option. With the VDU an important new facility has become available, namely the ability to display graphics as well as text in a program output, provided that the computer has a suitable configuration of hardware and software.

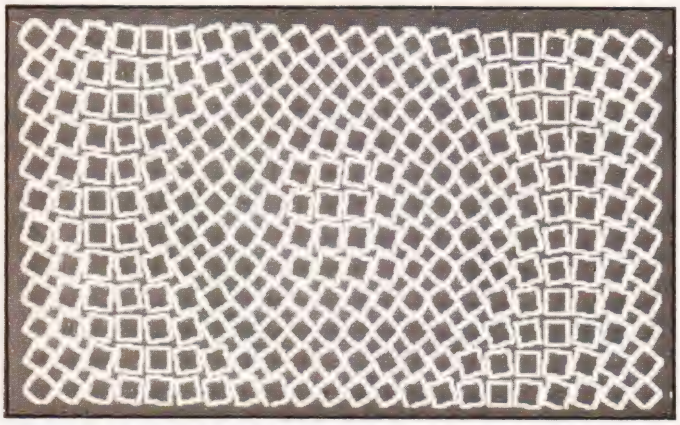




Life's Example

Whilst graphics have always been possible via special printers and X—Y plotters, the VDU offers greater speed and, importantly, permits dynamic as well as static displays. An application of graphics which is greatly enhanced by a CRT display, and which will be familiar to most readers, is J. H. Conway's game of "Life" (actually more of a simulation than a game) in which the birth, survival and death of a pre-defined pattern of cells is determined by a few simple rules.

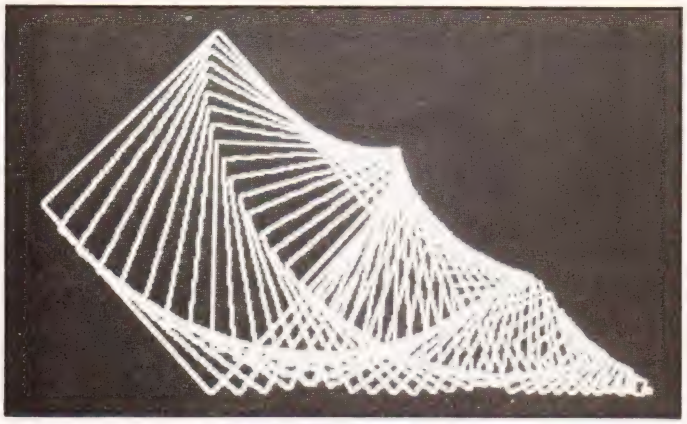


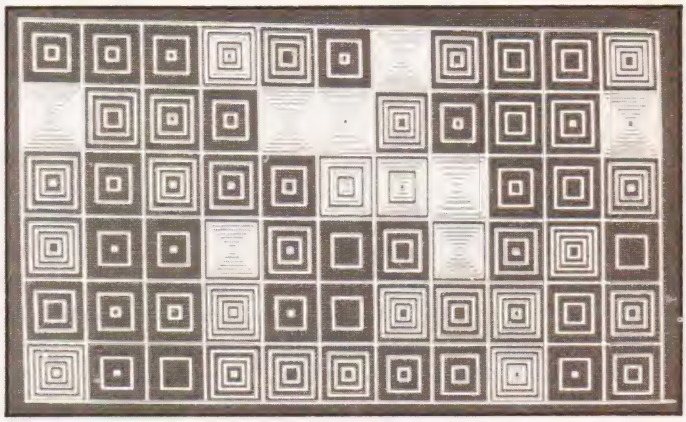


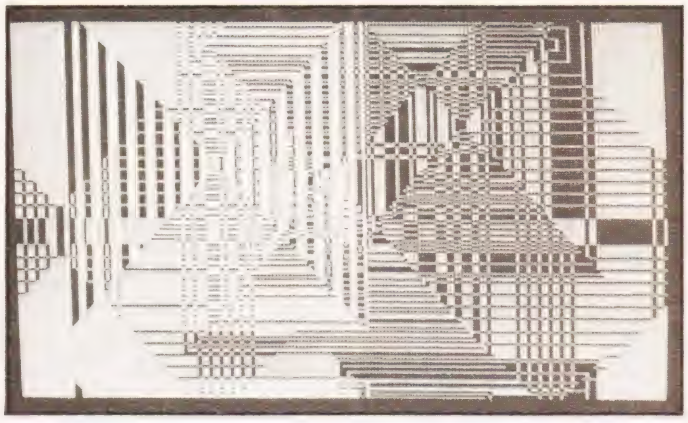
Although it is perfectly possible to observe the progress of the cell colonies on a printer, a VDU permits faster execution (important when some cell patterns can survive for tens or even hundreds of generations before reaching either a stable state or complete extinction) and allows the relationships between successive generations to be more easily observed. This particular simulation does not require the computer to have any special graphics facility as the cells can be represented by asterisks etc. and can be implemented on most computers either using a machine code program or using BASIC and POKEing the cells onto the screen, see this and other issues for versions of the program.

Graphic Generation

The graphics available up to the present on most microcomputers have been confined to 'pixel' graphics. Pixels are in fact graphics characters which have been pre-defined and stored in memory in exactly the same







manner as the text characters are stored in the character generator ROM. They are constructed within the same dot matrix format, e.g. 8x8, 9x7 etc., as the text characters. With a well designed set of predefined shapes such as are available on computers like the TRITON and PET, quite elaborate graphic effects have been achieved and numerous games are available which make full use of the facility. Some computers such as the Sorcerer permit a certain number of user-defined characters which can be stored in RAM to be recalled and employed as required. Pixel graphics have the advantage of economic memory usage but nevertheless place a restriction upon what can be displayed. Even when user-defined characters are possible their number is usually restricted to a maximum of 256. As each dot in a character matrix can be either off or on, the total number of possible combinations on an 8x8 matrix is 2 to the power 64 which is somewhere in the region of 1.84 x 10 to the power 19. Clearly a different arrangement is required to exploit the full potential definition of a VDU!

One possible solution is to use bit-mapped "high resolution" graphics such as those available on the Apple/ITT 2020 systems. In pixel systems each byte of video RAM stores one character. In bit-mapped systems each bit in the video RAM represents one dot on the screen. Hence the memory requirement for a bit-mapped system is much higher but it offer far greater flexibility. A pixel system typically uses 1K or 2K of video RAM whereas a bit-mapped system will utilise 8K to give a resolution of 280 x 192 (53760 individually addressable points) on the screen.

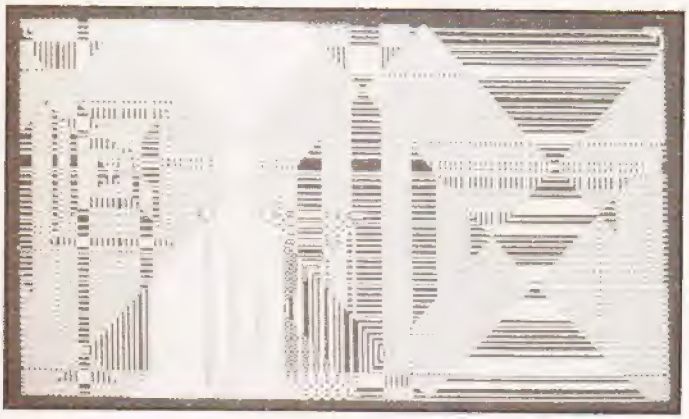
System Shortages

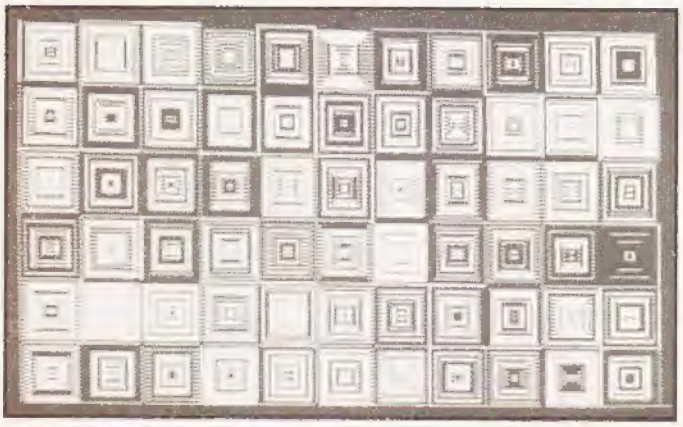
At present, apart from the Apple, there are relatively few computers in the 'personal' category which offer true "high resolution" graphics. The notable ones are the ITT 2020, Compucolor and HP85. However, the continuing reductions in the price of RAM is likely to mean that many of the more affordable personal computers will in future offer the facility. There is already a high resolution add-on package available for PET and the new, low cost Acorn Atom promises to offer high resolution graphics as an option.

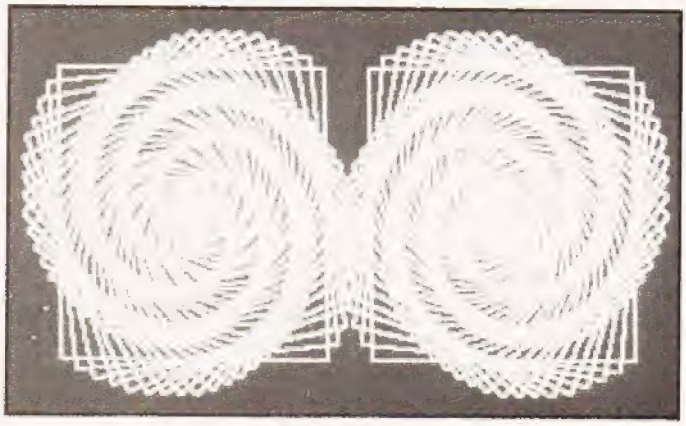
Computer graphics is an area which offers great opportunities for exploration and experimentation to the home user. And in education, teaching programs can often be made more effective by the use of maps and diagrams displayed as well as text. This is a case where one picture can indeed be worth a thousand words. CAL programs which would otherwise have to refer to separate illustrative material can now incorporate it directly. Graphs can be drawn in full definition rather than the bar form usually employed with pixel graphics. In the case of physics and electronics, complex waveforms can be synthesised by the addition of harmonics and displayed.

Computer animation is another possibility open to the home computer user. One American software company is currently offering a 3D animation package for the Apple. It allows scenes to be viewed from any angle and any distance and even rotated. A variable field of view permits zooming in on any particular part of the scene. The program is written in machine code and permits 100 — 150 lines per second to be projected so that a 20 line scene can be animated at about 5 frames per second. Such facilities lend themselves well to flight and driving simulations and indeed the same company sells a rather impressive flight simulator which offers a 3D "out-of-the-window" display as well as representation of the basic aircraft instrumentation.

COMPUTER GRAPHICS







Computer Art

Computer art has been around in various forms for as long as computers have existed although the term probably came into use in the mid 1960's. Several exhibitions have been held around the world but perhaps the most important was the 'Cybernetic Serendipity' exhibition, organised at the Institute of Contemporary Arts, London, by Jasia Reichardt in 1968. This demonstrated to the public, at a time before the silicon chip became a media cliché, the potential of the computer as a creative tool. At that time, and until recently, means of exploring that potential was limited to an elite few who had access to a computer to pursue their own interests. Some impressive work has been produced as well as much that is mediocre. Some artists have dismissed the medium as sterile and lacking 'soul' (usually on discovering that some knowledge of programming is required in order to proceed very far). On the other hand, programmers and engineers have often felt that 'that's not what computers are meant for'. In a few cases collaboration between artists and programmers has produced very worthwhile results. As a medium computer art is still very new and many critics find it hard to accept on the grounds that it requires no manual skill in the way that painting or sculpting does. It seems probable, however, that it is here to stay and the recent appointment of a Research Fellow in Computer Art at the Royal College of Art is an indication of a growing acceptance. Lower computer prices and wider availability of true high resolution graphics should help to speed its evolution.

The attractions of computer art are many and will appeal in differing degrees to different people:—

a) The computer can precisely execute a set of instructions which may be simple or complex to produce a visible result which the artist can either accept, modify or reject without having expended the time and effort required to produce a design manually.
b) The computer may either be given explicit instructions or may introduce random variations within limits set by the user.
c) The computer output may itself be considered as the work of art or it may act as a stimulus for further programming or for a manually produced work.

Artistic Attempts

The photographs accompanying this article are not claimed to portray any particular artistic merit but are intended to demonstrate the potential of a personal computer in producing programmed designs. All examples employ the single design element of a square, which has been manipulated in size, rotation and position to produce the results shown. Any other shape could have been defined and manipulated in similar ways. The computer used was an ITT 2020 and the photographs taken directly from a monochrome monitor screen. All programming was in BASIC and none of the programs were much longer than twenty lines. The more complex-looking results were achieved by using an EXCLUSIVE OR function so that a complementary colour was produced at the intersection of two lines.

CT would be very interested to see any examples of computer art generated by our readers, with a view to publication within the magazine. Any contributions used will be paid for. Write to the Editor at our 145 Charing Cross Road offices.

Part one of our monthly look at the available computer systems and peripherals.

ACT Microcomputers

SYSTEM 800
Dist:- ACT (Computers), Radclyffe House
66-68 Hagley Rd, Edgbaston, Birmingham, B16 8PF
021-455 8686
+ growing regional network

CPU 6502 **I/O** RS232 PARA **BASIC** Yes **DISC** 2x5¼" **RAM** 46K/ **CASS** N/A **Other** Various **m/c** MDOS

£3,950-8,950

Extras:- 8" disc, printers, modems
Applications:- Stand alone business system that can also run most PET software.

Acorn Computers

ATOM
Dist:- Acorn Computers
4A Market Hill
Cambridge
0223-312772

CPU 6502 **I/O** BUS PARA **BASIC** 8K **DISC** **RAM** 2K/11K **CASS** Kansas **Other** FP option **m/c** YES

£125 kit, £150 built

Extras:- Colour graphics, enhanced BASIC
Applications:- Cased single board with BASIC, can connect to Eurobus

ACORN
Dist:- Acorn Computers Ltd.
4A Market Hill
Cambridge
0223-312772

CPU 6502 **I/O** PARA BUS **BASIC** NO **DISC** NO **RAM** 1K/8K **CASS** CUTS **Other** NO **m/c** 2K

£65 upwards

Extras:- Rack based expansion capability.
Applications:- Single board controller with piggy back Hex + I/O.

ADDS

ADDS SYSTEM 75
Dist:- ADDS (UK) Ltd.
137 High Street
New Malden, Surrey
01-949 1272
Sold through dealer network

CPU 8085A **I/O** RS232 COMS **BASIC** YES **DISC** 2x8" **RAM** 52K **CASS** N/A **Other** Fortran uCobol **m/c** ADOS

£4,000 upwards, less printer

Extras:- Floppy, printer, system software
Applications:- Complete business system with supplied software and communications interface

Apple Computers

APPLE II
Dist:- Microsense, Maxted Road, Maylands Ave,
Hemel Hempstead,
Herts HP2 7LE
0442-41191

CPU 6502 **I/O** Various **BASIC** 2 versions **DISC** OPT **RAM** 16K/48K **CASS** YES **Other** Various **m/c** 2K

£695 upwards

Extras:- Various discs, colour graphics, I/O
Applications:- Neat cased system with excellent I/O capability including Prestel

Atari

ATARI 400
Dist:- Ingersoll Electronics
202 New North Road
London N1 7BL
01-226 1200

CPU 6502 **I/O** RS232 **BASIC** 18K **DISC** **RAM** 8K/16K **CASS** YES **Other** **m/c** shared

£400

Extras:- Printer
Applications:- Programmable games system grown up to home computer.

ATARI 800
Dist:- Ingersoll Electronics
202 New North Road
London N1 7BL
01-226 1200

CPU 6502 **I/O** RS232 **BASIC** 18K **DISC** **RAM** 16K/48K **CASS** YES **Other** **m/c** shared

£750

Extras:- Printer, discs, plug in software, modem
Applications:- Expanded version of 400 with wider applications

Athena

ATHENA 8285
Dist:- Butel-Comco Ltd.
50 Oxford Street,
Southampton
Hants SO1 1DL
0703-39890

CPU 8085A **I/O** RS232 **BASIC** YES **DISC** 2x5¼" **RAM** 64K **CASS** N/A **Other** Various **m/c** DOS

£3,380 upwards

Extras:- 8" discs, printer
Applications:- Complete integral desktop system

Attache

ATTACHE
Dist:- Friargrove Systems,
Suite 62, Outer Temple,
222 The Strand,
London WC2R 1BA
01-353 8267

CPU Z80 **I/O** RS232 **BASIC** YES **DISC** 2x8" **RAM** 64K **CASS** N/A **Other** Various **m/c** CP/M

£8,000

Extras:- Hard disc,
Applications:- Complete S100 based system with VDU, printer and software

Commodore Systems

PET
Dist:- Commodore,
360 Euston Road
London NW1 3BL
01-388 5702
+ many regional

CPU 6502 **I/O** IEEE PARA **BASIC** 8K **DISC** **RAM** 8K/32K **CASS** YES **Other** Forth Pascal **m/c**

£550 upwards

Extras:- Discs, printer, Many options
Applications:- Original complete desktop system

Compshop

UK 101
Dist:- CompShop
14 Station Road
New Bennet,
Herts EN5 1QW
01-441 2922

CPU 6502 **I/O** RS232 PARA **BASIC** 8K **DISC** **RAM** 4K/8K **CASS** YES **Other** NO **m/c** 2K

£199 kit, £249 built

Extras:- Memory, I/O, kit or built
Applications:- UK Implementation of Superboard

Compucolor

COMPUCOLOR II
Dist:- No current UK Main dealership, may re-stock when systems are UK modified

CPU 8080 **I/O** RS232 PARABUS **BASIC** YES **DISC** 5¼" **RAM** 8K/32K **CASS** NO **Other** NO **m/c** DOS

£1,200

Extras:- Second disc unit.

Applications:- Integral colour graphics system with poor UK reliability record

Cromemco

CROMEMCO SYSTEM 2
Dist:- Comart Ltd.
PO Box 2,
St Neots,
Huntingdon,
Cambs PE19 4NY
0480-215005
+ Many regional dealers

CPU	Z80	**RAM**	64K
I/O	RS232 PARA.P	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x5¼"	**m/c**	CDOS

£2,095-£7,000

Extras:- Hard option disc, multiple user capability, printer, etc.
Applications:- Development system, S100 based, with a wide range of software

CROMEMCO SYSTEM 3
Dist:- Comart Ltd.
PO Box 2,
St Neots,
Huntingdon,
Cambs PE19 4NY
0480-215005
+ Many regional dealers

CPU	Z80	**RAM**	64K
I/O	RS232 PARA.P	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x8"	**m/c**	CDOS

£3,745-£9,000

Extras:- Discs (inc hard), multi-user capability, printers, etc.
Applications:- S100 based professional system with a wide range of applications.

Equinox

EQUINOX IMS 5000
Dist:- Equinox Computers,
Kleeman House
16 Anning Street,
New Inn Yard,
London EC2A 3HB
01-739 2387

CPU	Z80	**RAM**	32K/48K
I/O	RS232 PARA	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£1,525 - £2,665

Extras:- 8" floppies, hard-discs, VDU, printer, etc.
Applications:- S100 based system with integral disc drives

Eurocalc

EUROC
Dist:- Eurocalc Ltd.
128/132 Curtain Road,
London EC2

CPU	8080	**RAM**	64K
I/O	PARA	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x8"	**m/c**	CP/M

01-729 4555
£8,000
+ Regional Distribution network soon

Extras:- Printers, WP keyboard, Hard disc
Applications:- Plessey manufactured system supplied complete with software and hardware

Exidy

EXIDY SORCERER
Dist:- Liverport Data Products
The Ivory Works,
St Ives, Cornwall
0736-798157
+ regional dealers

CPU	Z80	**RAM**	16K/48K
I/O	RS232 PARA	**CASS**	2
BASIC	Plug In 8K	**Other**	On disc
DISC	OPT	**m/c**	4K

£749 upwards

Extras:- Discs, printer, S100 adapter, Rom Pacs
Applications:- Keyboard based system using 'plug-in' software and expanding to discs

Heath Electronics

HEATHKIT H8
Dist:- Heath Electronics,
Bristol Road
Gloucester GL2 6EE
0452-29451

CPU	8080	**RAM**	4K/56K
I/O	Various	**CASS**	YES
BASIC	YES	**Other**	Various on disc
DISC	OPT	**m/c**	4K

+ London shop 01-636 7349

£275

Extras:- Discs, printer, VDU
Applications:- Bus based kit system of superb quality, large expansion possible

Hewart Microelectronics

HEWART 6800S
Dist:- Hewart Microelectronics
95 Blakelow Road,
Macclesfield,
Cheshire SK11 7ED
0625-22030

CPU	6800	**RAM**	16K/32K
I/O	RS232 PARA	**CASS**	2
BASIC	OPT 8K	**Other**	Pascal
DISC		**m/c**	1K/2K

£299 inc. keyboard

Extras:- 6809 upgrade, floppy discs using FLEX, case
Applications:- Naked 6800 development system.

HEWART 6800 MK4
Dist:- Hewart Microelectronics
95 Blakelow Road,
Macclesfield
Cheshire SK11 7ED
0625-22030

CPU	6800	**RAM**	16K/48K
I/O	choice	**CASS**	2
BASIC	OPT	**Other**	OPT
DISC	OPT		**m/c**

£160 upwards.

Extras:- SS50 range of boards.
Applications:- Naked bus based system, found useful in education/control.

Hewlett Packard

HP 85
Dist:- Hewlett Packard
King Street Lane,
Winnersh,
Wokingham, Berkshire
0734-784774

CPU	CUSTOM	**RAM**	16K/32K
I/O	IEEE RS232	**CASS**	CART
BASIC	32K	**Other**	
DISC		**m/c**	

£2,300

Extras:- All HP range of goodies.
Applications:- Integral printer system for desktop scientific use.

Interec Data Systems

SUPERBRAIN
Dist:- Icarus Computers,
27 Greenwood Place
London NW5 1NN

CPU	2xZ80	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£1,950 upwards

Extras:- 8" disc, standard software.
Applications:- S100 bus based complete unit of smart desktop type.

Ithaca Intersystems

ITHACA INTERSYSTEM 2
Dist:- Transam,
12 Chapel Street,
London NW1
01-402 8137
+ regional dealers

CPU	Z80A	**RAM**	8K/64K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	5¼" or 8"	**m/c**	CP/M

£700 upward

Extras:- Full range of S100 boards to IEEE spec.
Applications:- Flexible system that can be adapted to a wide range of uses.

ITT Consumer Products

ITT 2020
Dist:- Telefusion Ltd.,
61 Queens Square

CPU	6502	**RAM**	16K/48K
I/O	Various	**CASS**	YES
BASIC	Various	**Other**	Pascal

Bristol
0272-211446
+ many regional stockists

DISC OPT **m/c** 2K

£750 - £1,500

Extras:- Discs, Prestel, Printers.
Applications:- As Apple II, compatible UK version with standard colour graphics.

Luxor

ABC 80
Dist:- Luxor — CCS Microsales, 7 The Arcade, Letchworth, Herts.
04626-73301
+ 1 other

CPU Z80 **RAM** 16K/40K
I/O IEEE RS232 **CASS** YES
BASIC 16K **Other** Pascal
DISC 2x5¼" **m/c** 2K

£749

Extras:- Mainly software, I/O
Applications:- Complete cased system, Viewdata compatible

Microdata Computers

MICROLINK 1
Dist:- Microdata Computers, Belvedere Works, Bilton Way, Pump Lane Industrial Estate, Hayes, Middx UB3 3ND
01-848 9871

CPU Z80/F8 **RAM** 16K/32K
I/O RS232 PARA **CASS** CUTS 1200Bd
BASIC 8K **Other** Pascal soon
DISC NO **m/c** 3K

£3,500 upwards

Extras:- Printer, modem, etc.
Applications:- Portable data terminal using plasma flat screen display

Micro V

MICROSTAR 45
Dist:- Microsense Maxted Road, Maylands Avenue Hemel Hempstead, Herts HP2 7LE
0442-41191
+ small dealer network

CPU 8085A **RAM** 64K
I/O RS232 **CASS** N/A
BASIC YES **Other** Various
DISC 2x8" **m/c** *DOS CP/M

£4,800

Extras:- 20 Mb hard disc, VDU, printer
Applications:- Multi user business system

Midwest Scientific Instruments

MSI 6800 SYSTEMS
Dist:- Strumech, Portland House, Coppice Side Brownhills, Walsall West Midlands
05433-4321

CPU 6800 **RAM** 16K/56K
I/O RS232 **CASS** OPT
BASIC YES **Other** Various
DISC OPT **m/c** 1K+FDOS

£1,200 upwards

Extras:- Floppies, hard disc, printer, VDU.
Applications:- Ready built SS50 system expanding to full "System 12" with hard disc.

Nascom Microcomputers

NASCOM 1
Dist:- Nascom 92 Broad Street Chesham, Bucks HP5 3ED
02405-75151
+ regional network

CPU Z80 **RAM** 1K/6K
I/O RS232 PARA **CASS** YES
BASIC OPT **Other**
DISC **m/c** 1K

£125

Extras:- Motherboard, RAM, printer.
Applications:- Full keyboard machine code system, expandable.

NASCOM 2
Dist:- Nascom 92 Broad Street Chesham, Bucks HP5 3ED
02405-75151
+ regional network

CPU Z80 **RAM** 9K
I/O RS232 PARA **CASS** Kansas
BASIC 8K **Other**
DISC **m/c** 2K

£225

Extras:- Printer, RAM, case, discs.
Applications:- Low cost kit system, developed from Nascom 1.

National Panasonic

PANASONIC JD800/840
Dist:- Panasonic Business Equip. 9 Connaught Street London W2 2AY
01-262 3121
+ regional distributors

CPU 8085A **RAM** 56K
I/O RS232 **CASS** N/A
BASIC YES **Other** Cobol
DISC 2x8" **m/c** CP/M

£4,275 (hardware)
£8,000 upwards for packages

Extras:- Printers and software from regional distributors.
Applications:- Complete small business system with software support.

Newbear

77-68
Dist:- Newbear, 40 Bartholomew Street Newbury, Berks.
0635-30505
+ 2 regional shops

CPU 6800 **RAM** 4K/56K
I/O Various **CASS** YES
BASIC OPT **Other** NO
DISC **m/c** 1K

£40 upwards

Extras:- 6809 upgrade, I/O, discs.
Applications:- Rack based kit system.

Netronics

ELF II
Dist:- Newtronics, 255 Archway Road London N6
01-348 3325

CPU 1802 **RAM** ¼/4K
I/O Hex **CASS** OPT
BASIC OPT **Other**
DISC **m/c** 1K

£60

Extras:- Motherboard, RAM, I/O.
Applications:- Low cost kit for Hex programming.

EXPLORER 85
Dist:- Newtronics, 255 Archway Road London N6
01-348 3325

CPU 8085 **RAM** 4K
I/O 4x8, ser **CASS** YES
BASIC 8K OPT **Other**
DISC **m/c** 2K

£285 upwards

Extras:- Normal S100 goodies, case.
Applications:- Kit, S100 based.

North Star

NORTHSTAR HORIZON
Dist:- Comart Ltd., P.O. Box 2, St Neots Huntingdon, Cambs PE19 4NY
0480-215005
+ many regional dealers

CPU Z80 **RAM** 32K/56K
I/O RS232 PARA **CASS** N/A
BASIC YES **Other** Various
DISC 2x5¼" **m/c** CP/M

£1,600 - 2,000

Extras:- Discs, VDU, printer.
Applications:- S100 based system with good software support.

Ohio Scientific Instruments

SUPERBOARD II, C1
Dist:- Mutek, Quarry Hill, Box Wiltshire
0225-743289
+ many regional

CPU 6502 **RAM** 4K/8K
I/O PARA BUS **CASS** YES
BASIC 8K **Other** NO
DISC NO **m/c** 2K

£150
cased + psu + mod = C1@ £220

Extras:- Discs, Memory, case.

Applications:- Naked single board with BASIC, modified display for UK market.

CHALLENGER, C2
Dist:- Mutek,
Quarry Hill
Box, Wiltshire
0225-743289
+ many regional

CPU	6502	**RAM**	4K/32K
I/O	RS232 PARA	**CASS**	Kansas
BASIC	8K	**Other**	NO
DISC	OPT	**m/c**	2K

£349

Extras:- Disc, printer, memory.
Applications:- 4 slot backplane machine, upgraded system

CHALLENGER, C4
Dist:- Mutek,
Quarry Hill
Box, Wiltshire
0225-743289
+ many regional

CPU	6502	**RAM**	8K/32K
I/O	RS232 PARA	**CASS**	YES
BASIC	8K	**Other**	NO
DISC	OPT	**m/c**	4K

£395

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C8P
Dist:- Mutek,
Quarry Hill
Box, Wiltshire
0225-743289
+ many regional

CPU	6502	**RAM**	8K/32K
I/O	RS232 PARA	**CASS**	YES
BASIC	8K	**Other**	NO
DISC	OPT	**m/c**	4K

£475

Extras:- Discs, voice synth, colour graphics.
Applications:- Colour graphics version of C2 but with 8 slot backplane.

CHALLENGER, C3
Dist:- Mutek,
Quarry Hill
Box, Wiltshire
0225-743289
+ many regional

CPU	6502 6800 + Z80	**RAM**	48K/56K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x8"	**m/c**	DOS

£2,450

Extras:- VDU, printer, software
Applications:- Triple CPU system for business use etc.

Ontel

JEMINI
Dist:- Jaserve Ltd.
Stanhope Road,
Camberley, Surrey
0276-62282

CPU	8085A	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x8"	**m/c**	DOS

£9,200 upwards

Extras:- WP Software, printers, etc.
Applications:- VDU based package system.

Periflex

PERIFLEX 630/48
Dist:- Sintrom
Arkwright Road, Reading
Berks RG2 0LS
0734-85464

CPU	Z80	**RAM**	48K
I/O	Various	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M 2

£2,500

Extras:- VDU, printers, S100 board set.
Applications:- S100 based systems.

PERIFLEX 1024/64
Dist:- Sintrom
Arkwright Road, Reading
Berks RG2 0LS
0734-85464

CPU	Z80	**RAM**	64K
I/O	Various	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x8"	**m/c**	CP/M 2

£3,300

Extras:- VDU, printers.
Applications:- S100 based boxed computer.

Powerhouse

POWERHOUSE 2
Dist:- Powerhouse
5 Alexandra Road
Hemel Hempstead,
Herts HP2 5BS
0442-48422

CPU	Z80A	**RAM**	32K/64K
I/O	RS232 PARA.P	**CASS**	YES
BASIC	YES	**Other**	NO
DISC	OPT	**m/c**	2K

£1,250

Extras:- Graphics, I/O, printer.
Applications:- 5" VDU based system used in scientific and industrial control.

POWERHOUSE 3
Dist:- Powerhouse
5 Alexandra Road
Hemel Hempstead,
Herts HP2 5BS
0442-48422

CPU	Z80A	**RAM**	32K/64K
I/O	RS232 PARA.P	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£2,250 - 2,750

Extras:- Graphics, I/O, printer.
Applications:- 9" VDU based system with potential DP and small business applications.

Powertran

PSI COMP 80
Dist:- Powertran Electronics
Portway Industrial Estate
Andover, Hants SP10 3MN
0264-64455

CPU	Z80	**RAM**	3K/32K
I/O	Various	**CASS**	Kansas
BASIC	2K	**Other**	NO
DISC		**m/c**	1K

£255

Applications:- Mathematical/number crunching with special on-board chip.

Rair

BLACK BOX
Dist:- Rair Ltd.
30-32 Neal Street,
London WC2H 9PS
01-836 4663

CPU	8085A	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£2,500 upwards

Extras:- VDU's, printer, hard and floppy discs.
Applications:- Disc based professional system capable of handling up to 16 terminals.

Research Machines

RML 380Z
Dist:- Research Machines
P.O. Box 75,
Mill St, Oxford
0865-49791

CPU	Z80	**RAM**	16K/56K
I/O	Various	**CASS**	YES
BASIC	YES	**Other**	Various
DISC	OPT	**m/c**	3K

£897 upwards

Extras:- Graphics, printer, etc.
Applications:- Educational system of high quality.

Rockwell

AIM 65
Dist:- Pelco Electronics
Enterprise House
83-85 Western Road
Hove, Sussex BN3 1UB
0273-722155
+ several regional outlets

CPU	6502	**RAM**	1K/4K
I/O	RS232 PARA	**CASS**	2
BASIC	8K op	**Other**	
DISC		**m/c**	8K

£265 upwards

Extras:- Discs, RAM, VDU, cases, etc.
Applications:- Versatile single board with single lir.. display and thermal printer

Sanyo

SYSTEM 7000
Dist:- Memory Computers (UK)
Denjon House,
11 Denmark Street
London WC2
01-836 5342

CPU Z80 **RAM** 32K/64K
I/O RS232 **RAM** N/A
BASIC YES **Other** Various
DISC 2x5¼" **m/c** CP/M

£6,950 (complete systems)

Extras:- 8" floppies, printers, etc.
Applications:- Complete VDU based system well established in Europe.

SGS Ates

NANOCOMPUTER
Dist:- SGS Ates/
Midwich,
9 Churchgate Street
Old Harlow, Essex CM17 0JS
0279-412605

CPU Z80 **RAM** 4K/16K
I/O RS232 **CASS** YES
2xPIO
BASIC 8K opt **Other**
DISC **m/c** 2K

£240 upwards

Extras:- Experimenter systems, full system capability.
Applications:- Educational single board that can grow to fill system.

Sinclair Research

ZX80
Dist:- Science of Cambridge
6 Kings Parade
Cambridge
Cambs CB2 1SN
0223-311488

CPU Z80 **RAM** 1K/14K
I/O PARA **CASS** YES
BUS
BASIC 4K **Other** NO
DISC NO **m/c**
£80 kit, £100 built

Extras:- Kit or ready built, PSU, RAM
Applications:- Touch keyboard, low-cost beginners/educational system

Sharp Electronics

MZ-80K
Dist:- Sharp UK Ltd.
Thorp Road, Newton Heath
Manchester M10 9BE
061-205 2333
+ growing regional

CPU Z80 **RAM** 6K/34K
I/O PARA **CASS** YES
BASIC 14K **Other**
DISC **m/c** 4K

£480 to £599

Extras:- Discs, printer, I/O adapter
Applications:- Japanese desktop system expanding to business market.

Smoke Signal

SMOKE SIGNAL CHIEFTAN
Dist:- Strumech
Portland House, Coppice Side,
Brownhills, Walsall
West Midlands
05433-4321
+ Windrush

CPU 6800 **RAM** 32K/56K
I/O RS232 **CASS** N/A
SS50 BUS
BASIC YES **Other** Various
DISC OPT **m/c** 1K+DOS

£3,000

Extras:- Floppies, printers, VDUs.
Applications:- Mainly supplied to education and research although suitable for business.

Sord

SORD M100 ACE
Dist:- Midas Computer Services
2 High Street,
Steyning, Sussex
0903-814523
+ some regional distributors

CPU Z80 **RAM** 48K
I/O Various **CASS** N/A
BASIC YES **Other** Fortran
DISC 2x5¼" **m/c** SOS

£1,000 upwards

Extras:- Disc, colour graphics, printers.
Applications:- S100 based disc system from Japan mainly aimed at the educational market.

Southwest Technical Products

SWTP 6800/6809
Dist:- Southwest Technical
38 Dover Street,
London W1X 3RB
01-491 7507

CPU 6800 **RAM** 8K/56K
6809
I/O Various **CASS** YES
BASIC Various **Other** Various
DISC OPT **m/c** 2K

£

Extras:- Discs, printer, VDU.
Applications:- SS50 based system with good software support.

Tandy Corporation

TRS-80 Level 1 & 2
Dist:- Tandy Corp.,
Bilston Road, Wednesbury
West Midlands WS10 7JN
021-556 6101
+ regional shops

CPU Z80 **RAM** 4K/48K
I/O OPT **CASS** YES
BASIC 2 versions **Other** Fortran
DISC OPT **m/c** 4K

£380 - £560

Extras:- Discs, printers, I/O.
Applications:- Top selling system with "separates" approach.

TRS-80 II
Dist:- Tandy Corp.,
Bilton Road, Wednesbury
West Midlands, WS10 7JN
021-556 6101
+ regional shops

CPU Z80 **RAM** 32K/64K
I/O RS232 **CASS** N/A
PARA
BASIC YES **Other**
DISC 8" **m/c**

£2,000 upwards

Extras:- Printer, disc.
Applications:- Upgraded business version of Model I.

Tangerine Computers

MICROTAN 65
Dist:- Tangerine Computers
Forehill, Ely, Cambs.
0353-3633

CPU 6502 **RAM** 1K/48K
I/O PARA **CASS** OPT
BUS
BASIC OPT 10K **Other** NO
DISC NO **m/c** 1K

£69 upwards

Extras:- Tanex board for I/O, BASIC, etc + racking,cases.
Applications:- Machine code system, kit or built that expands to a full computer.

MICRON
Dist:- Tangerine Computers
Forehill,Ely,Cambs.
0353-3633

CPU 6502 **RAM** 8K
I/O RS232 **CASS** YES
PARA
BASIC 10K **Other** NO
DISC NO **m/c** 3K

£395 inc

Extras:- RAM, discs, I/O in rack system.
Applications:- Cased built system with excellent expansion possibilites.

Technalogics

TECS
Dist:- Technalogics
8 Egerton St.Liverpool,
Merseyside L8 7LY
051-724 2695
+I Regional Distributor

CPU 6800 **RAM** 16K/56K
I/O RS232 **CASS** 2
PARA
BASIC 3K **Other** YES
DISC OPT **m/c** 4K

Extras:- Discs, Memory, Prestel Software.
Applications:- Prestel/Teletext terminal option to home system.

Texas Electronic Instruments

TEI 208-212
Dist:- Abacus,
62 New Cavendish Street,
London W1M 7LD
01-580 8841

CPU Choice **RAM** 32K/60K
I/O PARA **CASS** N/A
SERIAL
BASIC YES **Other** Various
DISC 2x5¼" **m/c** CP/M

£3,535 - £4,497

Extras:- 8" discs (212) printers, hard disc soon.
Applications:- Integral VDU models forming the basis of a business system

Texas Instruments

TI 99/4
Dist:- Texas Instruments,
European Consumer Division,
Manton Lane,
Bedford MK41 7PA
0234-67466
+ dealer network

CPU 9900 **RAM** 16K
I/O PARA **CASS** 2
BUS
BASIC 14K **Other** NO
DISC OPT **m/c** 12K

£995

Extras:- Discs, speech synthesiser
Applications:- Colour graphics machine with "plug-in" software. Needs US TV.

Transam

TRITON
Dist:- Transam,
12 Chapel Street, London NW1
01-402 8137

CPU 8080 **RAM** 1K/3K
I/O PARA **CASS** YES
BUS
BASIC Various **Other** Pascal
DISC OPT **m/c** Various

£294 to £1,000

Extras:- Cases, Discs, Motherboard, Assembler package
Applications:- Versions available for most requirements, from educational to research.

TUSCAN
Dist:- Transam Computers
12 Chapel St. London NW1
01-402 8137

CPU Z80 **RAM** 1K/8K
I/O RS232 **CASS** YES
PARA
BASIC OPT **Other** Pascal
DISC OPT **m/c** 2K

£195 upwards

Extras:- Casing, VDU option, discs, Firmware, S100 boards
Applications:- S100 based kit, development style system. Also ready built

Vector Graphic

SYSTEM B
Dist:- Sintrom.
Arkwright Road, Reading
Berks RG2 0LS
0734-85464
+ many regional

CPU Z80 **RAM** 64K
I/O Serial **CASS** N/A
PARA
BASIC Various **Other** Various
DISC 2x5¼" **m/c** CP/M 2

£3,200 upwards

Extras:- Printer, software, S100 boards
Applications:- Serious computing package complete with VDU and software

VECTOR GRAPHIC 2800
Dist:- Sintrom,
Arkwright Road, Reading
Berks RG2 0LS
0734-85464
+ many regional

CPU Z80 **RAM** 64K
I/O SERIAL **CASS** N/A
PARA
BASIC Various **Other** Various
DISC 2x8" **m/c** CP/M 2

£3,995 upwards

Extras:- Printers, S100 boards, software
Applications:- Data processing and scientific/industrial computing. Terminal based system.

VECTOR GRAPHIC 3030
Dist:- Sintrom.
Arkwright Road, Reading.
Berks RG2 0LS
0734-85464
+ many regional

CPU Z80 **RAM** 64K
I/O SERIAL **CASS** N/A
PARA
BASIC Various **Other** Various
DISC 2x5¼" **m/c** CP/M 2
32Mb HD

£TBA

Extras:- Printers, S100 boards, software.
Applications:- Hard disc based terminal system for DP.

Video Genie

VIDEO GENIE
Dist:- Lowe Electronics
Bentley Bridge, Chesterfield Road,
Matlock, Derbyshire DE4 LEF
0629-2817
+ dealer network

CPU Z80 **RAM** 16K/48K
I/O PARA **CASS** YES
BUS
BASIC 10K **Other**
DISC **m/c** 2K

£425 inc VAT

Extras:- Printer, discs via Tandy.
Applications:- HONG KONG copy of TRS-80 Model 1 and runs all TRS software.

Xerox

DIABLO 3000
Dist:- Business Computers.
The Pagoda, Theobald Street,
Borehamwood, Herts WD6 4RT
01-207 3344

CPU 8085 **RAM** 32K/64K
I/O RS232 **CASS** N/A
BASIC YES **Other** DACL
DISC 2x8" **m/c** DOS

£8,950-£15,000

Extras:- Business software, Printer, Communications adapter
Applications:- Complete business system that can be multi-tasked. Price includes software.

DIABLO RANGER 3200
Dist:- Business Computers.
The Pagoda, Theobald Street,
Borehamwood, Herts WD6 4RT
01-207 3344

CPU 8080 **RAM** 32K/64K
I/O RS232 **CASS** N/A
BASIC YES **Other** DACL
DISC 2x8" **m/c** DOS

£10,865-£50,000

Extras:- Up to 4 discs, Up to 2 hard discs, Printers, Communications adapter.
Applications:- Complete system that can run up to eight jobs simultaneously, price includes software.

Zenith Data Systems

ZENITH Z89
Dist:- Zenith Data Systems.
Heath Electronics. Bristol Road
Gloucester GL2 6EE
0452-29451
+ London shop 01-636 7349

CPU Z80 **RAM** 16K/64K
I/O RS232 **CASS** OPT
(H88)
BASIC YES **Other** Various
DISC 5¼" **m/c** 8K

£1,570 upwards

Extras:- Dual discs, printer.
Applications:- Integrated system of very high quality, also available as a kit.

ZENITH Z11
Dist:- Zenith Data Systems.
Heath Electronics, Bristol Road
Gloucester GL2 6EE
+ London shop 01-636 7349

CPU LSI 11 **RAM** 16K/32K
I/O Various **CASS** N/A
BASIC YES **Other** Various
DISC OPT2x8" **m/c** N/A

£1,250

Extras:- Discs, printer, VDU.
Applications:- LSI 11 compatible 16 bit system.

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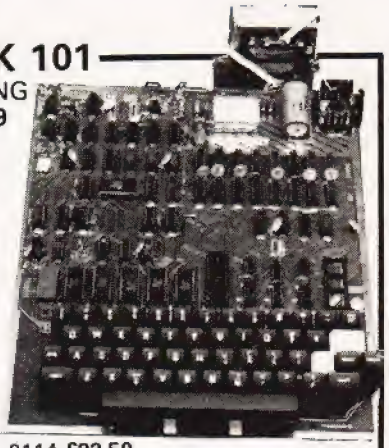

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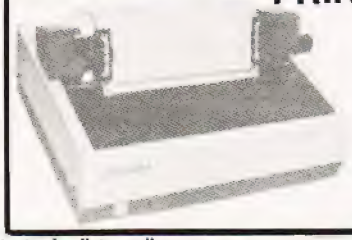
74LS02	.18	74LS38	.23	74LS96	1.16	74LS157	.57	*74LS194	.86	74LS283	1.09
74LS03	.19	74LS40	.20	74LS107	.32	74LS158	.57	74LS195	.97	74LS289	4.50
74LS04	.20	74LS42	.65	74LS109	.32	74LS160	1.09	74LS196	.97	74LS290	.91
74LS05	.22	74LS47	.81	74LS112	.32	74LS161	.69	74LS197	.97	74LS293	.91
74LS08	.20	74LS48	.81	74LS113	.32	74LS162	1.16	74LS221	.92	74LS295	1.30
74LS09	.22	74LS49	.81	74LS114	.32	74LS163	.69	74LS240	2.08	74LS298	1.16
74LS10	.20	74LS51	.18	74LS122	.69	74LS164	1.06	74LS241	2.08	*74LS348	1.39
74LS11	.20	74LS54	.18	74LS123	.72	74LS165	.72	74LS242	2.08	74LS352	1.04
74LS12	.20	74LS55	.18	74LS124	1.39	*74LS166	1.65	74LS243	2.08	74LS353	.92
74LS13	.37	74LS73	.33	74LS125	.36	74LS168	1.71	74LS245	2.50	*74LS362	4.21
74LS14	.65	74LS74	.30	74LS126	.36	74LS169	1.71	74LS247	1.09	74LS365	.55
74LS15	.20	74LS75	.40	74LS132	.60	74LS170	1.72	74LS248	1.09	74LS366	.55
74LS20	.20	74LS76	.27	74LS133	.39	74LS173	.81	74LS249	1.09	74LS367	.55
74LS21	.20	74LS78	.27	74LS136	.36	74LS174	.97	74LS251	.96	74LS368	.55
74LS22	.20	74LS83	.78	74LS138	.65	74LS175	.97	74LS253	.92	*74LS373	.78
74LS26	.20	74LS85	.81	74LS139	.65	74LS181	2.77	74LS257	.92	74LS386	.36
74LS27	.20	74LS86	.27	74LS145	.97	*74LS188	2.75	74LS258	.92	*74LS393	.84
74LS28	.22	74LS90	.57	74LS151	.81	74LS189	2.08	74LS259	1.39	*74LS668	1.17
74LS30	.20	74LS91	.97	74LS153	.52	74LS190	.86	74LS261	4.50	74LS670	1.71
74LS32	.26	74LS92	.69	74LS154	1.30	74LS191	.86	74LS266	.37		

PRINTERS



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Dot-matrix printer with Pet graphics Interface: Centronics parallel, options: PET, Apple and serial.

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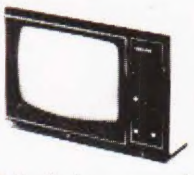

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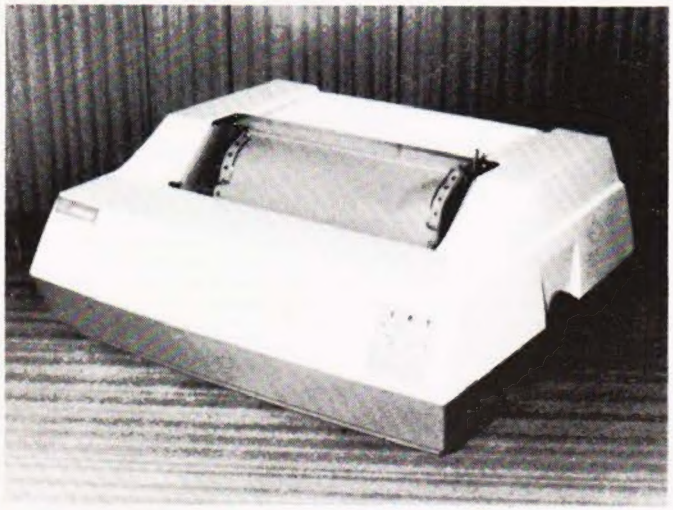

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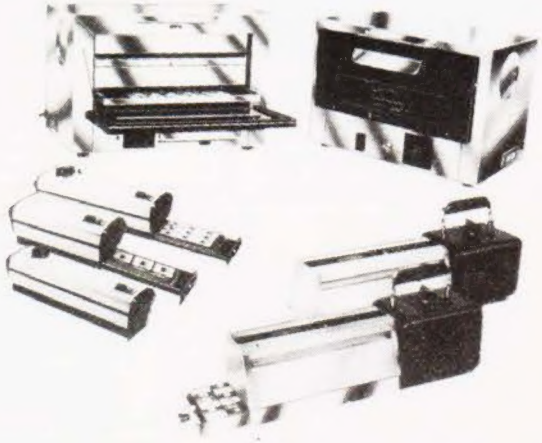

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